NUCLEAR SCIENCE ABSTRACTS

These abstracts are prepared from Atomic Energy Commission documents which are not classified for security reasons, and from articles appearing in the published literature, both domestic and foreign, pertaining to atomic energy.

The abstracts in this journal are arranged according to broad subject categories with the abstracts of the AEC documents appearing first in each category. An author, a subject, and a foreign geographic index are provided with each issue. Cumulated indices will be provided for each semi-annual volume.

Documents indicated for sale may be purchased from

Document Sales Agency
P. O. Box 62
Oak Ridge, Tennessee

All other documents either appear in published literature or are for official use only, and are not for sale by any agency of the AEC.

Nuclear Science Abstracts is now available on a subscription basis.

For the twelve issues of Vol. I (July through Dec. 1948) $7.75

For the twelve issues of Vol. II (Jan. through June 1949) $3.00

NUCLEAR SCIENCE ABSTRACTS

Volume 2 Number 8

Chemistry Library
QC
770
.U5-6
v.2
no.8

Contents for April 30, 1949

Category	Page
Absorption and Scattering of Radiation	334
Atomic Bombs and Warfare	335
Atomic Power and Piles	336
Biological Effects of Radiation	336
Biology, General	337
Ceramics and Refractories	338
Chemistry, Analytical	338
Chemistry, General	339
Cosmic Radiation and Mesons	344
Geology and Geophysics	351
Health Protection	351
Instruments	352
Isotopes	353
Isotopes Separation	354
Mass Spectrography	354
Metals and Metallurgy	354
Mineralogy and Mineral Resources	356
Neutrons	356
Nuclear Properties	360
Nuclear Transformation	361
Particle Accelerators	364
Physics, General	364
Physics, Nuclear - Methods of Measuring	366
Physics, Theoretical	371
Radiation Sickness	373
Radioactivity	374
Radiography	379
Radiotherapy	380
Rare Earths and Rare Earth Compounds	381
Scientific Research and Laboratories	384
Spectrography	384
Tracer Applications - Biology	385
Tracer Applications - Chemistry	386
Tracer Applications - Industry	386
Tracer Applications - Physics	386
Transuranic Elements	386
Uranium and Uranium Compounds	388

LOCATION LIST

Atomic Energy Commission Declassified Documents

Document No.	Abstract No.	Page
AECD-2499	1657	374
AECD-2499-A	1658	374
AECD-2499-B	1659	374
AECD-2499-C	1660	374
AECD-2499-D	1661	374
AECD-2499-E	1662	374
AECD-2499-F	1663	374
AECD-2499-G	1664	374
AECD-2499-H	1665	375
AECD-2499-I	1666	375
AECD-2530	1701	381
AECD-2530-A	1702	381
AECD-2530-B	1703	381
AECD-2530-C	1704	381
AECD-2530-D	1705	381
AECD-2530-E	1706	381
AECD-2530-F	1707	382
AECD-2530-G	1708	382
AECD-2530-H	1709	382
AECD-2530-I	1710	382
AECD-2530-J	1711	382
AECD-2531	1712	382
AECD-2531-A	1713	382
AECD-2531-B	1714	382
AECD-2531-C	1715	383
AECD-2531-D	1716	383
AECD-2532	1622	364
AECD-2533	1596	356
AECD-2534	1613	361
AECD-2535	1631	366
AECD-2536	1632	367
AECD-2537	1741	388
AECD-2538	1597	357
AECD-2539	1614	361
AECD-2540	1717	383
AECD-2541	1742	388
AECD-2542	1633	367
AECD-2543	1736	386
AECD-2544	1737	387
AECD-2545	1738	387
AECD-2546	1623	365
AECD-2547	1667	375
AECD-2548	1668	375
AECD-2548-A	1669	375
AECD-2548-B	1670	375
AECD-2548-C	1671	375
AECD-2548-D	1672	376
AECD-2548-E	1673	376
AECD-2548-F	1674	376
AECD-2548-G	1675	376
AECD-2549	1518	339
AECD-2549-A	1519	339
AECD-2549-B	1520	339
AECD-2549-C	1521	340
AECD-2549-D	1522	340
AECD-2549-E	1523	340
AECD-2549-F	1524	340
AECD-2549-G	1525	340
AECD-2549-H	1526	341
AECD-2550	1676	376
AECD-2550-A	1677	376
AECD-2550-B	1678	377
AECD-2550-C	1679	377
AECD-2550-D	1680	377
AECD-2550-E	1681	377
AECD-2550-F	1682	377
AECD-2550-G	1683	377
AECD-2551	1684	378
AECD-2551-A	1685	378
AECD-2551-B	1686	378
AECD-2551-C	1687	378
AECD-2552	1527	341
AECD-2552-A	1528	341
AECD-2552-B	1529	341
AECD-2552-C	1530	341
AECD-2552-D	1531	342
AECD-2552-E	1532	342
AECD-2553	1582	354
AECD-2554	1533	342
AECD-2555	1739	387
AECD-2556	1534	342
AECD-2556-A	1535	342
AECD-2556-B	1536	342
AECD-2556-C	1537	343
AECD-2556-D	1538	343
AECD-2556-E	1539	343
AECD-2556-F	1540	343
AECD-2556-G	1541	343
AECD-2556-H	1542	343

LOCATION LIST

Atomic Energy Commission Unclassified Documents

Document No.	Abstract No.	Page
AECU-151 (LAMS-838)	1624	365
AECU-152 (UCRL-271)	1547	344
AECU-153 (Y-340)	1743	388
AECU-154 (UR-63)	1512	337
AECU-155 (LADC-645)	1497	334
AECU-156 (LADC-644)	1598	357
AECU-157 (LADC-647)	1615	362
AECU-158 (LADC-649)	1616	362
AECU-159 (LADC-643)	1634	367
AECU-160 (M-4303)	1506	336
AECU-161 (Y-355)	1718	383
AECU-162 (ORNL-314)	1635	367
AECU-163 (LA-725)	1617	363
AECU-164 (BNL-T-8)	1548	345
AECU-165 (UR-65)	1513	338
AECU-166 (K-363)	1636	368
AECU-167 (M-4297)	1650	371

ABSORPTION AND SCATTERING OF RADIATION

1497 Observation of 20 Mev Gamma Rays from the $T^3(p,\gamma)He^4$ Reaction by H V Argo, H T Gittings, A Hemmendinger, G A Jarvis, H Mayer, and R F Taschek. AECU-155 (LADC-645) nd 1p

This document is in abstract form; it is reproduced below in its entirety.

A comparison of the absorption in aluminum of beta rays produced by thick-target gamma rays from the $T^3(p,\gamma)He^4$ and $Li^7(p,\gamma)Be^8$ reaction has been made using triple coincidence counters. A thick target of T^3 absorbed in a disc of zirconium and an incident proton energy of 1.01 Mev was used. An estimate of total cross section for this reaction will be given.

1498 Coherent Scattering of Radiation and Negative Energy States by Otto Halpern and Harvey Hall Phys Rev 75 910-911 (1949) Mar 1 (Letter to the editor)

It has been generally accepted that in the absence of real pairs, the theoretical expressions for the scattering cross section are identical, whether negative energy states are assumed to be free or occupied. However, the fact that the theorem cannot apply, e.g. to coherent scattering processes in which the initial and final state are the same or to incoherent scattering processes leading to final bound states, has been overlooked. The authors discuss the theory and conclude that not only the proof concerning the equivalence of the 2 versions of the theory [Dirac, Proc Roy Soc London 126 360 (1930)] is erroneous, but also that the 2 theories lead to different predictions concerning experimental results.

1499 Investigation of Protons Produced by the Bombardment of Magnesium by Deuterons (Issledovanie protonov, obrazuiushchikhsia pri bombardirovke magnila deitronami) by I A Nemilov and L I Gedeonov Doklady Aka Nauk SSSR 63 115-118 (1948) (In Russian)

Experiments have been carried out in order to determine the energy of the protons resulting from fission of magnesium. The existence of groups of protons with various energies was established, and the energy of each group has been determined. The energy of the deuterons was 3.9 Mev. The magnesium target, obtained in a vacuum by means of powdering, was 2-3 μ thick. A graph shows the results of a photometric recording made on one of the photoplates in order to obtain an exact determination of the limits of its various grades of dimness, and thus, of the energies of the various groups of particles, developing at the nuclear reaction. Such graphs have been drafted for each of the 4 photoplates included. The results of the determination of the energies and of the relative intensities of the groups are presented in a table. All measurements have been carried out for particles emerging at an angle of 130-150° with the direction of the beam of primary deuterons. The authors say that the observed groups of protons pertain to the reaction with the magnesium isotope Mg^{24}.

1500 A Note on the Determination of the Rates of Energy Loss of H^1 and H^2 Nuclei in Gold and Aluminum by T A Hall and S D Warshaw Phys Rev 75 891-892 (1949) Mar 1 (Letter to editor)

Previously reported measurements [Wilcox, Phys Rev 74 1743 (1948)] of the energy loss of slow nuclear particles passing through thin metallic foils have been extended. In the newer measurements further refinements were made in the experimental techniques so as to increase the accuracy of the results. Data were taken which indicate that deuterons and protons both have the same rate of energy loss, in disagreement with the results reported by Wilcox. Preliminary results indicate that the rate of loss in aluminum is somewhat less (about 25%) than that reported by Wilcox, while the shape of the curve is substantially the same. A complete report of these measurements, including the use of beryllium as a stopping substance, will be published soon.

ABSORPTION AND SCATTERING OF RADIATION (continued)

1501 On Radiative Corrections to Electron Scattering by Julian Schwinger Phys Rev 75 898-899 (1949) Mar 1 (Letter to the editor)

The radiative correction to the cross section for essentially elastic scattering of an electron by a Coulomb field has been computed with the form of quantum electrodynamics developed in several recent papers [Phys Rev 74 1939 (1948); 75 651 (1949)]. In addition to the emission and absorption of virtual quanta, the real emission of quanta with maximum energy ΔE, which is small in comparison with $W = E - mc^2$, the initial kinetic energy of the electron, has been included. Thus, only those inelastic events in which a small fraction of the original energy is radiated, are treated. An expression is obtained for the fractional decrease in the differential cross section for scattering as a function of the scattering angle. The expression is interpreted physically for the cases of the nonrelativistic limit and the extreme relativistic limit. A numerical calculation is made which indicates that radiative corrections to scattering cross sections can be appreciable.

ATOMIC BOMBS AND WARFARE

1502 Nuclear Weapons by A W Betts Military Engr 41 104-107 (1949) March-April

It is emphasized first that because of the necessity for assembling a critical mass in a time interval of the order of a small fraction of a second, it is highly improbable that a nuclear weapon can be developed which will be small enough to be man handled. Second, the methods of detonation and the fusing problems of the bomb are sufficiently complicated to demand a level of training higher than that previously required of members of the Armed Forces. Third, there is at present no adequate protection against the bomb short of preventing its delivery. Fourth, nuclear weapons have not reached their maximum size in the present type bomb, and new types may come into being which will be considerably more powerful than present models; moreover, they are not confined to bombs but, subject to size, may be made as warheads for almost any type of delivery in use today in modern armies; and last, that the development of nuclear power for military vehicles is not "just around the corner."

1503 Radiological and Salinity Relationships in the Water at Bikini Atoll by William L Ford Trans Amer Geophysical Union 30 46-53 (1949) Feb

The circulation in Bikini Lagoon during the post-Baker Day period is deduced from the distribution of salinity and radioactivity. The use of the distribution of radioactivity as a method of determining the circulation is compared with other methods. The presence of radioactivity in the waters of the lagoon as a result of the explosion presented a unique opportunity to obtain a partial evaluation of the radioactive tracer technique in problems of hydrography. Figures showing a circulation scheme and the distribution of salinity and radioactivity are presented for the third, fourth, and fifth day after the underwater explosion. The circulation at this time was found to be abnormal due mainly to the unusual weather conditions. It has therefore been discussed with particular reference to the areas of concentration of the radioactive material in view of the possible bearing on studies of the effect of radiological contamination on marine flora and fauna at Bikini. The use of radioactivity in tracing water motions at Bikini gave results which were in general agreement with those obtained by other methods.

1504 What Every Medical Officer Should Know about the Atomic Bomb J Roy Army Med Corp 91 158-179 91948) Oct. 219-238 (1948) Nov. 282-293 (1948) Dec

These articles are reprinted from Bull U S Army Med Dept 8 187-198, 269-283, 350-362, 422-433, 504-517 (1948). Abstracts of the articles have been listed in Nuclear Science Abstracts as abstract nos. I-537, -1532, -1825 and -1923).

ATOMIC POWER AND PILES

1505 Engineering Problems in Atomic Energy for Industrial Application by J A Hutcheson. Mining and Met 29 484-485 (1948) Sept

Engineering problems that must be solved before the building of the first practical electric power generating station are reviewed. Information is needed concerning the following: the neutron-absorption characteristics of materials as well as the structural characteristics of those materials which appear applicable for reactors; data relative to the corrosive prevention of radiation leaks in probable electric power generating system; the selection, removal, and replacement of fuel elements in any section of a nuclear power-generating equipment; determination of the effect of radiations from a nuclear reactor upon the crystal lattice of materials used in a reactor when exposed continually for long periods of time.

BIOLOGICAL EFFECTS OF RADIATION

1506 Radiation Sensitivity of Cells during Mitotic and Meiotic Cycles with Emphasis on Possible Cyto-Chemical Changes by A H Sparrow. AECU-160 (M-4303) nd 65p

Original data on sensitivity changes to x-rays during the nuclear cycle in Trillium erectum are presented. They show late prophase and metaphase to be highly sensitive to x-ray breakage and early interphase to be of low sensitivity. The tendency of broken ends to rejoin seems to be inversely related to the amount of fragmentation per unit dosage. The general significance of these conclusions is discussed in the light of other work on sensitivity changes during nuclear division. The distribution of chromosome breaks within chromosomes and the relationship of breakage to mutation are also discussed. The factors affecting nuclear radiosensitivity are considered under the following topics: morphological and structural differentiation within the nucleus; sub-microscopic, cytochemical and cytophysiological factors; effects of mitotic inhibitors, mitotic poisons and other miscellaneous substances; and effects of physical factors.

It appears that the condensed state of the chromosome (late prophase, metaphase, anaphase) is one of high sensitivity to breakage and that the diffuse stages such as telophase, interphase and early prophase are relatively much less sensitive. Possible reasons for these differences are considered and possible mechanisms whereby the processes initiated by ionizations produce effective chromosome breaks are presented and discussed.

1507 The Fast Neutron Hazard by Titus C Evans Nucleonics 4 No. 3, 2-8 (1949) March (See also MDDC-1450)

Recent experiments have been made to obtain information on the biological effects of fast neutrons (1-4 Mev) using mice as test objects. The chief purpose of the investigations was to determine whether distribution of the exposure in time would alter the relative effectiveness of neutrons (ca. 4 Mev) as compared to X-rays (185 kv). The effects of the 2 types of radiations were determined under 3 conditions of exposure: (1) single acute, (2) multiple subacute, and (3) multiple very small or chronic. Data on the number of survivors and mean survival time are shown in a number of curves. An equivalence of 1 n = 10 r has been accepted as a temporary working basis for permissible exposures; however, the difficulty in converting data of the type obtained into data applicable to humans, is noted.

1508 Histamine in Rat Plasma: Correlation with Blood Pressure Changes Following X-irradiation by R P Weber and F R Steggerda Proc Soc Exptl Biol and Med 70 261-263 (1949) Feb

Rats, after X-irradiation with mid-lethal dosage (600 r) show assayable histamine in concentrations of 1 to 2 γ per 2 cc of blood plasma at 2 hour and 5 day intervals following the irradiation. Rats irradiated similarly to those used in the histamine assay experiments show a fall in blood pressure that correlates with the appearance of histamine in blood plasma and strongly suggests that histamine is responsible for the lowered blood pressure. Rats, from 4 to 6 days after a mid-lethal dosage of irradiation, show a loss in appetite and weight, and a critical fall in blood pressure from which only 50% will recover. The rest died within 9 or 10 days after the irradiation was given.

BIOLOGICAL EFFECTS OF RADIATION (continued)

1509 Medical and Biological Aspects of Nuclear Energy by Andrew H Dowdy. Douglas Aircraft Company Inc Project RAND Report RAD-202 (University of Rochester) Aug 13 1947 37p

In this review paper, University of Rochester experiments and results are described for the effects of chronic and acute X-radiation and chronic neutron irradiation upon peripheral blood changes (red blood cell count, lymphocyte count, polymorphonuclear count and platelet count), incidence of leukemia, mortality, body weight changes, sterility in the male (aspermia, sperm reduction, sperm motility, and abnormal sperm form), genetic changes (mutations) and histogenetic changes (chromosome abnormalities). Dogs, rabbits, monkeys, rats and fruit fliew were the subject of experimentation.

It was concluded that genetic changes are the most sensitive indicators of x-radiation, that chromosome damage is directly proportional to total number of roentgens received, and that alteration in sperm could be detected in the cases of chronic radiation down to dosage levels as low as 0.1 r/day. Lymphocytes are the most sensitive to radiation, followed closely by polymorphonuclears and platelets; red blood cells are more resistant. Chronic x- and neutron irradiation increases the incidence of leukemia; the life span of small animals is reduced in proportion to the number of roentgens of x-radiation received. It appears that any amount of penetrating radiation is detrimental and that many of the responses studied fall into the non-threshold group.

1510 The Relation of Atmosphere to Biological Effects of X-Rays by Barbara Hayden and Luther Smith Genetics 34 26-41 (1949) Jan

Barley seeds X-rayed while in a vacuum consistently showed better germination and growth and a lower frequency of chromosomal aberrations than seeds X-rayed in air. In one test the seedling mutation rate from test of plants grown from germinating seeds X-rayed in a vacuum was $2.1 \pm 0.32\%$ as compared with $3.4 \pm 0.35\%$ for seeds X-rayed in air. This difference was slightly more than three times the standard error. Root-tip cells from seeds irradiated in air averaged 4.7 times as many chromatinic bridges as root-tip cells from seeds irradiated in a vacuum.

1511 A Simple Device for Exposure of Groups of Mice to Uniform X-Ray Doses by Alvin Haber Science 109 260 (1949) March 11

Circles of 1/2 in-thick plywood, 5 1/2 in or 7 1/2 in in diameter are enclosed in a 2 in-wide strip of 1/4 in-mesh wire hardware cloth, so that the discs are mounted in the middle of the wire cloth band. The cover is made by stretching a piece of plastic screen mesh, such as ordinarily used in window screening, across an embroidery hoop of the proper diameter. 1 figure

BIOLOGY, GENERAL

1512 Beryllium Sulfate Mist Inhalation Study at Approximately 50 Mg/M^3 by G Sprague, R Meier, A Pettengill, F Smith, J Scott, and H E Stokinger. AECU-154 (UR-63) Feb 16 1949 30p

The inhalation toxicity of beryllium sulfate mist at a mean concentration of 46.7 mg/m^3 was studied in a total of 126 animals including 11 species. An LD_{50} or greater was obtained among the following species: monkey, goat, rat, dog, cat, guinea pig, and hamster. There was no mortality of swine or fowl. The histologic response of the lungs of dying animals among the monkey, goat, dog, cat, and rabbit was quite similar. An exudative response was observed in the terminal bronchi and alveolar sacs in which many neutrophiles and mononuclear cells were seen. Marked hyperplasia was present in the smaller bronchi of the dog. Atelectasis with fibrotic areas was most marked in the cat. Significant body weight loss was noted in the monkey, dog and cat. The guinea pig showed the greatest gain. Marked proteinuria increasing with time was detected in 4 of 5 dogs. There were no other biochemical changes of significance.

Except for one instance of tubular necrosis of the kidney in a hamster, no lesions were found in organs other than the lungs of sacrificed animals. An interesting observation was a change during the course of exposure of a granulocytic type of exudate to a phagocytic one. This was seen clearly in

BIOLOGY, GENERAL (continued)

the rabbit, dog and cat. The granulocytic response was seen during the first 2 or 3 weeks of exposure, the predominately mononuclear reaction at about 7 weeks. The rabbit showed the most pure monocytic response. Hematologic changes of note were a leukocytosis in the dog and rat, a rise in platelets in the rat and rabbit, and a downward trend in the erythrocyte count of the dog. The monkey, goat, dog, cat, rabbit and pig are considered quite sensitive to the beryllium sulfate mist at 46.7 mg/m^3; the hamster mouse and chicken relatively resistant.

1513 The Inhalation Toxicity of Beryllium Sulfate Mist in Animals at a Concentration of 10 Mg/M^3 for 95 Days by George F Sprague Jr, Alton Pettengill, Burrell Brown and Herbert E Stokinger. AECU-165 (UR-65) Feb 24 1949 37p

The inhalation toxicity of beryllium sulfate mist at 10 mg/m^3 has been determined in a study involving a total of 126 animals comprising 7 species. This study represents the third in a series of studies in which successively lower concentrations of beryllium (viz., 4.2, 2.0 and 0.4 mg Be/m^3) were employed for the purpose of establishing its toxic affects at known exposure limits. The ultimate objective of these studies was the determination of the "safe" level of exposure. The entire study extended over a period of 95 calendar days during which time the animals received a total of 426 cumulative hours of exposure. An evaluation of toxicity was based upon mortality, body-weight response, hematologic, pathologic and biochemical changes. The distribution of animals in the plan for recording the various toxicologic criteria is shown in tabular form. Control data were collected during a 3-week conditioning period when the animals were being acclimated to exposure conditions in a beryllium-free atmosphere.

CERAMICS AND REFRACTORIES

1514 Design of Ceramic Tensile Testing Machines for Elevated Temperatures by Frank Silberstein. New York State College of Ceramics Report No. 22 June 23 1948 9p (NP-666)

Designs for two proposed ceramic tensile testing machines are discussed. The first is a 10,000 lb self-powered unit; it is rigidly constructed and provides ample space for the installation of a furnace. The second is of 5000 lbs capacity and is powered from a laboratory source of oil pressure.

1515 High Temperature Laboratory Kiln by Ernest H Faust Jr and James Tinklepaugh. New York State College of Ceramics Report No. 20 June 23 1948. 13p (NP-665)

The design and firing behavior of a gas fired, stabilized zirconia-lined, high temperature kiln is described. If a satisfactory material can be found for use in the fire parts this kiln may be fired to temperatures exceeding 3600°C.

1516 Investigation of Pure Oxide Ceramic Materials Intended for High Temperature and High Stress Applications by Frederic O Hess. U S Office of Military Government for Germany Report FIAT-FR-924 Sept 4 1946 27p

The German technique and practices in the field of manufacture and application of pure oxide ceramic materials for high temperature and high stress applications is reviewed, i.e. Al_2O_3, MgO, BeO and some special bodies such as SiC. A translation of a test report of SiC turbine blade material is included.

CHEMISTRY, ANALYTICAL

1517 Physico-Chemical Investigation of Ion Exchangers. Technical Report - February 1, 1949 by A W Davidson, W J Argersinger Jr, R W Stoenner and W K Lowen. University of Kansas Feb 1 1949 131p (NP-623)

Studies have been made of cation exchange reactions between the synthetic resin known as Dowex-50 and solutions of unit total ionic strength containing pairs of the following cations: hydrogen

CHEMISTRY, ANALYTICAL (continued)

and sodium, ammonium, silver, thallous, nickel, calcium respectively. By analysis of the solutions for both cations of the pair, after equilibrium with the resin had been attained, it has been established that in no case does exchange of cations take place on a simple equivalent basis. The number of equivalents of one cation passing from the resin to the solution is appreciably greater than the number of equivalents of the other cation lost by the solution to the resin. The fact is attributed to a secondary reaction, of the nature of hydrolysis of the resin, which takes place during the exchange process. With solutions containing silver or thallous ion, an opposite effect, attributed to adsorption, is observed. Suitable corrections having been made for the hydrolytic and adsorption effects, the equilibrium activity quotients were calculated. These values are not constant for any given exchange pair, but exhibit a somewhat regular drift with variation in the composition of the exchange solution. This deviation from the law of mass action is attributed to the error involved in identifying the activities of the components of the resin with their respective mol fractions. 54 references.

CHEMISTRY, GENERAL

1518 Papers for Plutonium Project Record, Volume 9B, Chapter 2, 3, 4, ed. by N Sugarman. AECD-2549 nd Decl Mar 22 1949 128p For publication in NNES

The individual papers of this document are abstracted below.

1519 Construction and Use of an Ionization Chamber with Electrometer Tube Amplifier by M S Freedman. AECD-2549-A nd 28p

The construction of the instrument adheres to the following general principles. The ionization chamber either contains the active sample internally or has a wall or window transparent to the radiations. It is filled with a gas, usually air, at atmospheric pressure or higher, in which the ionization is induced by radiations. An electric field is maintained between two electrodes in the chamber, sufficient to collect practically all the primary ions formed by the radiation in the chamber, (the voltage necessary to ensure collection of nearly all the ions formed is called the saturation voltage), but insufficient to form secondary ions by collision processes. The radiation intensity is measured by detecting either: (a) the rate at which the potential of an electrically isolated electrode is changing by by virtue of the ionic charge being collected on it (drift rate method), or (b) if the ionic charge is allowed to flow off the electrode through a high resistance, the steady state alteration in the electrode potential due to the ion current in the resistance (deflection method). Either of these techniques may be used with either of two types of detection, D. C. or A. C. Details of the construction and operation of the D. C. type amplifier and ionization chamber widely used on the project for β- and γ-ray measurements are included. Other types of ionization chambers useful for certain special problems are discussed briefly.

1520 The Valence States of Fission Se and Te in Aqueous Solutions by C W Stanley and T H Davies. AECD-2549-B nd 7p

Analytical procedures for aqueous tellurite ion in the presence of tellurate ion and for selenite in selenate solutions have been tested. For the reduction of tellurite to metal, H_2S was used; SO_2 was used for selenite. A method for the reduction of tellurite ion at an electrode has been developed. These procedures have been used to determine the chemical states of radio-Te and Se produced in U fission with some variation of chemical conditions. Both fission products appear preponderantly in the more reduced state, except radio-Te from uranium peroxide fission in alkaline solution, 90 per cent of which is found as tellurate ion. No evidence for the metallic state or for telluride or selenide species was observed.

CHEMISTRY, GENERAL (continued)

1521 Exchange Among Several States of Iodine and the Chemical State of Radioiodine from Te Decay by Warren H Burgus and T H Davies. AECD-2549-C nd 16p

The exchange in acid solution of I_2 with IO_3^-, I_2 with IO_4^-, and IO_3^- with IO_4^-, and in alkaline solution of IO_3^- with IO_4^- has been investigated by using radioisotopes. In no case was rapid exchange observed. The isotope 2.4h I^{132} growing in 0.1M HNO_3 from both radio-tellurite and tellurate ions was fractionated among a periodate, an iodate, and a reduced (iodide, iodine and hypoiodite) fraction. From both sources, most of the radioiodine was found in the reduced fraction. The chemical states of 2.4h I^{132}, 8d I^{131} and 22h I^{133} formed by fission in basic solution have been examined. The distribution was found to vary with the particular isotope.

1522 The Chemical Effects of Nuclear Transformations: β-Decay of Se to Br by R R Edwards, H Gest and T H Davies. AECD-2549-D nd 31p

Radioactive Br grown from aqueous selenite and selenate ions has been chemically characterized. Usually a third of the product Br was found as BrO_3^-, the remainder in more reduced states. The Se isotope employed and presumably the decay energy has been varied without effect upon Br distribution. Inappreciable quantities of BrO_3^- were observed from the decay of metallic Se dissolved in benzene in contact with an aqueous phase. The reactivity of Br from aqueous selenite decay has been tested with CH_3CHBr_2. One fourth of the bromine products appeared to combine with the reagent. The energy available for chemical processes by nuclear electron emission is discussed. The opinion is advanced that the observed effects do not proceed from recoil but from some other source which cannot as yet be identified.

1523 Flow Type Ionization Chamber by Edward R Tompkins. AECD-2549-E nd 5p

In the use of ion exchange columns for the remote control separation of radioisotopes, it is desirable to know the level of activity in the effluent solutions at all times. This allows "cuts" to be taken in such a way as to obtain maximum purity and recovery. To accomplish this it was necessary to construct an ionization chamber which could be used, in conjunction with a conventional type amplifier and recorder, to furnish a continuous record of the activity in the effluent solutions. The original model ionization chamber of the "flow type" is shown diagrammatically and is described. This chamber is sensitive largely to β-radiations of sufficiently high energy to penetrate the 20 mg/cm wall. In the design of an all-column apparatus for fission product separation it was necessary to devise an instrument whose sensitivity extended over a wider range. Furthermore, it seemed that by recording the β- and γ-radiations intensities separately it would be possible to differentiate between elements of similar chemical properties more closely. For this reason a new ionization chamber was constructed; details are shown.

1524 Glass Solution Distributors for Remote-Control Operations by L G Stang and H A Lévy. AECD-2549-F nd 5p

Mechanically and magnetically operated glass devices for directing the flow of solutions by remote control are described.

1525 A Polarographic Cell for use in Remote-Control Systems by C M Nelson, D N Hume and H A Levy. AECD-2549-G nd 4p

A cell in which remotely controlled polarographic analysis can be carried out is shown. With the exception of the outlet valve and the tygon tubing connector, the construction is entirely of glass. For operation, a gentle vacuum is applied to the gas-outlet tube bringing active solution from the appropriate vessel into the cell through the sample inlet line. When the cell is filled, the vacuum is released and excess solution is allowed to return to its sources. Hydrogen gas is then bubbled for several minutes through the gas inlet tube to remove dissolved O_2, after which the cell is ready for polarographic measurements.

CHEMISTRY, GENERAL (continued)

1526 A Laboratory for Research Operations at High Levels of Radioactivity by H A Levy. AECD-2549-H nd 28p

Laboratory facilities for radiochemical research are classified according to the level of radioactivity involved in the operations. The classifications microcurie, millicurie and multicurie are useful ones. Problems often require manipulations at more than one of these levels; the prosecution of low-level work in the immediate neighborhood of high level activities is to be avoided, and consequently separate facilities for work at more than one level may be needed in a single laboratory. Microcurie level: Ordinary chemical facilities are satisfactory. Counting and other measuring instruments are best located in a constant-temperature, shielded room. Millicurie level: Shielding is needed between the operator and equipment, which necessitates the construction of specially designed hoods. Vessels containing active materials can sometimes be manipulated from a distance by means of special tongs. Shielded vaults for stored samples and a waste-disposal system are necessities. Special apparatus for often-repeated operations, e.g., the removal of an aliquot from a solution is desirable. Radiation-monitoring is required for safe operation. Multicurie level: Manipulations must be completely remotely-controlled and carried out behind heavy, permanent sheilding. Contamination of the laboratory and equipment by radioactive materials in quantities dangerous to personnel is a major problem. Drains and storage facilities for highly-active waste liquors are required. Radiation-monitoring, preferable automatic is essential, and an alarm system to indicate dangerously high radiation is desirable.

Work involving ponderable quantities of α-emitters of intermediate life (10^5y or less) presents special problems because of the high toxicity of the material. Photographs and drawings of equipment are included.

1527 Papers for Plutonium Project Record, Volume 9B, Chapter 8, ed. by N Sugarman. AECD-2552 nd Decl Mar 23 1949 59p For publication in NNES

The individual papers of this document are abstracted below.

1528 Preparation of Carrier-Free Sr and Ba Tracer by Using $Pb(NO_3)_2$ and $PbCrO_4$ Precipitations by L E Glendenin. AECD-2552-A nd 6p

A method is given for the preparation of carrier-free Ba and Sr tracers, based on the carrying of radioactive Ba and Sr on $Pb(NO_3)_2$, precipitated with fuming HNO_3 and subsequent separation of Ba from Sr by carrying active Ba with $PbCrO_4$ precipitated in buffered acetic acid solution, in which Sr is soluble. The radiochemical yields are ~ 30-75 per cent and the tracers have high radiochemical purity.

1529 Some Unit Operations for the Preparations of Carrier-Free Sr by P C Tompkins, L Wish and J X Khym. AECD-2552-B nd 16p

Radioactive Ba and Sr isotopes arising from U fissions have been separated from a variety of solutions by coprecipitation with $PbSO_4$. The efficiency for Ba is greater than 95 per cent, while that for Sr is about 80 per cent. Conditions are given for several operations that may be used to separate the Ba, Sr and Pb to result in a "carrier-free" (no added carrier) Sr preparation. The reactions discussed include: coprecipitation of $SrSO_4$ with $PbSO_4$, metathesis of $PbSO_4$ to $PbCO_3$, partial separation of Pb as $PbCl_2$, separation of Pb and Ba from Sr by chromate precipitation, separation of Ba and Sr as carbonates from plumbite solution, separation of Ba, Sr, and Pb from Ca, etc. with fuming HNO_3, and the separation of Ba from Sr by precipitation of the former with HCl-ether.

1530 Procedures for the Separation of Carrier-Free Sr and High Specific Activity Ba From UNH by Means of $PbSO_4$ by P C Tompkins, A Broido, G W Parker, E R Tompkins, W E Cohn, W Kisieleski and R D Finkle. AECD-2552-C nd 9p

A procedure is given by which "carrier-free" Sr is prepared from active solution arising as a by-product of Pu separation, or from the dissolution of pile-irradiated U in HNO_3. The overall Sr recovery is about 30 per cent. The essential steps are precipitation of $PbSO_4$, metathesis to $PbCO_3$,

CHEMISTRY, GENERAL (continued)

separation of the bulk of the Pb as $PbCl_2$, further purification through fuming HNO_3 precipitations, separation of Ba as $BaCl_2$ and the final removal of Pb as PbS. Another procedure is presented to recover Sr arising as a by-product of Ba separations. The source is an HCl-ether filtrate from $BaCl_2$ precipitation. The excess acid is removed by evaporation, the Pb dissolved in NaOH, the Sr precipitated on $BaCO_3$ or $CaCO_3$, and further purified as in the first method. Sr recovery is 80-90 per cent.

1531 Determination of Cd Activity in Fission by R P Metcalf. AECD-2552-D nd 3p

A procedure is presented for the separation of Cd activity from the other fission products, based on the precipitation of CdS with H_2S in dilute acid solution and scavenging with basic ferric acetate.

1532 The Radiochemical Determination of Total Sb Tracer Activity and Differential $Sb^{(III)}$ and $Sb^{(V)}$ Activities by W F Boldridge and D N Hume. AECD-2552-E nd 24p

A study has been made of several gravimetric methods to determine the recovery of added Sb carrier. The interchange between Sb carrier and tracer in different valance states was also investigated. Procedures are given for the determination of total Sb-tracer activity by use of $CrCl_2$ solution or pyrogallol and for the determination of Sb(III) tracer in the presence of Sb(V) by use of CsCl to form $Cs_3Sb_2Cl_9$.

1533 A Note on the Effect of the HCl Concentration on the Heat of Solution of Thorium Tetrachloride by E F Westrum Jr and H P Robinson. AECD-2554 (ANL-HDY-619) nd 3p

The need of checking certain calorimetric techniques provided an opportunity to make heat of solution measurements on a very pure sample of anhydrous throium tetrachloride, which was sublimed in a quartz tube in high vacuum to eliminate any oxychloride present. The value of Chauvenet [Annales de Chemie et de Physique 23, ser. 8, p425 (1911)] for the heat of formation of $ThCl_4$ is based upon heats of solution of Th in about 3.6 molar HCl and $ThCl_4$ in water (-56.7 Kcal $mole^{-1}$). Present data indicate that the neglect of the HCl concentration in the combination of these thermochemical data makes this value of the heat of formation about 9 kcal too large.

1534 Papers for Plutonium Project Record, Vol 9B, Chapter 8, ed. by N Sugarman. AECD-2556 nd Decl Mar 24 1949 43p For publication in NNES

The individual papers of this document are abstracted below.

1535 The Interchange of Radioactive Iodine with Carrier by L E Glendenin, R P Metcalf and T B Novey. AECD-2556-A nd 9p

The interchange of radioactive I with carrier I in procedures used in early fission yield experiments has been tested. Results from this investigation indicate that the interchange between radioactive I and carrier I obtained by these methods is incomplete. Modification of these procedures, by providing for oxidation of I-carrier to IO_4^- with NaOCl in basic solution and reduction of the IO_4^- to I^- with HSO_3^- in acid solution before the standard extraction of elementary I_2 with CCl_4 is found to effect complete interchange between radioactive 2.4h I^- and I^- carrier.

1536 Preparation of Carrier-Free I by D S Ballantine. AECD-2556-B nd 3p

Two procedures for the isolation of carrier-free I^{131} are presented. The first method makes use of the production of 8d I^{131} by irradiation of Te with thermal neutrons. Neutron bombardment of stable Te produces Te^{131} (by an n,γ reaction), which decays with a 30h period to I^{131}. The second method uses the NHO_3 condensate from dissolving U metal as its source of I^{131}. The carrier-free I^{131} obtained by both procedures contains only a few milligrams of solid material, and the radiochemical purity is 99 per cent.

CHEMISTRY, GENERAL (continued)

1537 Perchlorate Method for the Determination of Cs Activity in Fission by L E Glendenin and C M Nelson. AECD-2556-C nd 6p

A procedure is presented for the isolation of Cs activity from the other fission elements, making use of the precipitation of $CsClO_4$ from $HClO_4$ with absolute ethanol. The interference of alkali metals is eliminated by a preliminary separation of Cs from the interfering elements with silicotungstic acid. Tracer tests indicate excellent separation from other fission activities.

1538 Bismuth Iodide Method for the Determination of Cs Activity in Fission by H B Evans. AECD-2556-D nd 4p

A procedure is presented for the separation of Cs activity from fission material, which makes use of the precipitation of $Cs_3Bi_2I_9$ with BiI_3 in HI. This precipitation reaction is specific for Cs and provides effective decontamination from the other fission elements.

1539 Preparation of Carrier-Free Cs Tracer with Ammonium Carrier by L E Glendenin and C M Nelson. AECD-2556-E nd 3p

A procedure is presented for the preparation of carrier-free Cs tracer, making use of the coseparation of 33y Cs^{137} activity from fission material on NH_4ClO_4 precipitated from $HClO_4$ with absolute ethanol. The method is simple and rapid, and it provides excellent decontamination from other fission elements. The final product is free of solids and is present in water solution together with a small amount of $HClO_4$.

1540 Preparation of Carrier-Free Cs Tracer by B Finkle and W E Cohn. AECD-2556-F nd 4p

A procedure for the preparation of carrier-free Cs^{131} activity is presented which makes use of the production of Cs^{131} by irradiation of Ba with pile neutrons. Neutron bombardment of a stable Ba salt produces 12d Ba^{131}, which decays by K capture to 10.2d Cs^{131}. The Ba is removed by $BaCl_2$ precipitation with concentrated HCl. Further purification is provided by $La(OH)_3$ scavengings. The final product, free from inert solids, is obtained radiochemically pure.

1541 Determination of Ba Activity in Fission by L E Glendenin. AECD-2556-G nd 7p

A rapid method for the determination of Ba activities based upon the simple precipitation, weighing and mounting of $BaCl_2 \cdot H_2O$, is presented. The precipitation reagent is a solution consisting of 5 parts concentrated HCl and 1 part ethyl ether in which the solubility of $BaCl_2$ is less than 1 part in 120,000. The precipitation is sufficiently quantitative to permit standardization of Ba carrier solution by weighing $BaCl_2 \cdot H_2O$ after alcohol-ether washing and vacuum desiccation. The composition of the precipitate is shown to be reproducible by the standarization results of several analysts. The separation from other fission activities, including Sr, is shown to be satisfactory by tracer tests. The analytical results obtained by several analysts on a fission product solution are satisfactory.

1542 Separation of Pb Carrier From Active Ba by CCl_4 Volatilization by N Elliott. AECD-2556-H nd 7p

Carbon tetrachloride reacts readily in the vapor phase at 500°-600°C with $PbSO_4$ and $BaSO_4$ to form the chlorides, $PbCl_2$ and $BaCl_2$. In the course of the reaction, the S forms volatile oxychlorides, and the $PbCl_2$ sublimes, leaving behind $BaCl_2$. The separation is complete, and the recovery of Ba is quantitative. Some research has been conducted with equipment which allows remote control of operations.

CHEMISTRY, GENERAL (continued)

1543 A Carrier-free Separation of Radioactive Indium from Cadmium (Eine traegerlose Trennung des Radioactiven Indiums von Cadmium) by E Jacobi Helv Phys Acta 22 66-68 (1949) (In German)

By the method described, 0.2 mg of indium can be separated from a large quantity of cadmium in 10 minutes. Mg is added as a carrier and precipitated with an excess of ammonia. The radioactive In is carried by $Mg(OH)_2$, while Cd remains in the solution. It is then electrolytically deposited, carrier-free, from a weak H_2SO_4 solution, onto a small thin piece of mica.

1544 Comparative Studies of Gallium Chemistry. Period: Dec 1, 1948 - Feb 1, 1949. University of Illinois Bimonthly Report No. 10 nd 21p (NP-674)

A spectrophotometric examination of Tl(I) oxinate in $CHCl_3$ showed this compound to have absorption peaks with maxima at 310, 325, 338, and 395 mμ. The 395 mμ peak obeys Beer's Law. This compound is both thermally and photochemically active in $CHCl_3$ solution. The absorption spectra of Al(III) and In(III) oxinates were observed and compared to the absorption spectra of Ga(III), Tl(III), and Tl(I) oxinates. The chemical and physical properties of these oxinates were compared.

The use of oxine as a reagent for the gravimetric determination of thallium was investigated. Determinations on samples ranging from 1.0 to 200.0 mg of Tl show that the oxinate method is precise, rapid, and simple. The low solubility and large equivalent weight of $Tl(C_9H_6NO)_3$ favor the use of this method as a means of determining thallium.

The buffering power of sodium acetate in respect to Tl(III) ion in dilute sulfuric acid solution was investigated. Thallic hydroxide begins to precipitate at a pH of 7.0 under these conditions. Studies on the relationship of pH and extraction characteristics of acetate buffered Tl(III) solutions show the optimum extraction range using oxine in $CHCl_3$ is 6.5 to 7.0. This extraction method is not suitable for quantitative extraction of Tl(III) from aqueous solution due to the sharp extraction range, the large excess of oxine necessary, and the photochemical instability of thallium oxinate solutions in bright daylight.

1545 Preparation of Radioactive Iodocasein by C F Hamilton, Marschelle H Power and A Albert J Biol Chem 178 213-216 (1949) Mar

A procedure for the preparation of radioactive iodocasein of sufficient radioactivity and biologic activity for use in physiologic amounts in human metabolic studies is described.

1546 The Synthesis of 17-(Methyl-C^{14})-Testosterone and 21-C^{14}-Progesterone by Harold B MacPhillamy and Caesar R Scholz J Biol Chem 178 37-40 (1949) Mar

The two steroid hormones, methyltestosterone and progesterone, with radioactive C^{14} in the side chain have been synthesized. For the first, Miescher's method in which androstene-3, 17-dione 3-enol ether reacts with 1 mole of the Grignard reagent was used; for the second, the general method for the preparation of ketones developed by Gilman and Nelson was used as a basis.

COSMIC RADIATION AND MESONS

1547 Some Preliminary Cloud Chamber Photographs of Artificial Mesons by Walter Hartsough, Evans Hayward and Wilson M Powell. AECU-152 (UCRL-271) nd 4p

A cloud chamber operated in the neutron beam, which is produced when 350-Mev protons strike a two-inch copper target, was used to produce photographs of meson tracks. Two photographs show (1) the first meson observed; its radius of curvature corresponds to a π-meson of 2.3 Mev or a μ-meson of 3.0 Mev and (2) the capture of a negative meson by a nucleus, presumably an argon nucleus. Other tracks on the film are discussed.

COSMIC RADIATION AND MESONS (continued)

1548 Two Papers on Cosmic Ray Phenomena by Bruno Rossi. AECU-164 (BNL-T-8) July 15 and Aug 12 1948 45p

Interpretation of Cosmic Ray Phenomena. Instrumental developments were mainly responsible for the transition from the first to the second period of cosmic ray research which took place around 1930. During the first period, which may be considered to begin with Hesse's balloon flights in 1912, the interest of cosmic ray workers centered on the dependence of cosmic ray intensity on altitude or depth on solar or sidereal time, on meteorological factors, and on geographical location. Practically all experiments were made with the ionization chamber, an instrument which measures the integrated effects of all rays traversing a certain volume of gas during fairly long time intervals. The most important result of these experiments was the proof of the extraterrestrial origin of cosmic rays. The second period began with the invention of the Geiger-Mueller counter tube and with the systematic application of the cloud chamber technique to cosmic ray studies. Both the Geiger-Mueller tube and the cloud chamber are capable of detecting single cosmic ray particles and afford means to investigate their interaction with matter. It soon became apparent that these interactions lead to secondary phenomena of extreme complexity and cause profound changes to occur in the composition of the cosmic radiation as it proceeds through the atmosphere. The interest of cosmic ray workers suddenly shifted toward the problem of establishing the nature of the particles responsible for cosmic ray effects and of reducing the seemingly infinite variety of these effects to a small number of elementary phenomena. Great progress has been made toward the solution of this problem, to the point that it now appears possible to draw a consistent picture of all the main cosmic ray phenomena. The broad outlines of this picture are presented in this paper.

Disintegration and Nuclear Absorption of Mesons. The particles described as "mesons" in the present paper are the so-called ordinary mesons, which form the major portion of the hard component of cosmic rays at sea level. They are characterized by their mass, which is approximately 210 electron masses, and by their property of undergoing spontaneous decay with a mean life of approximately 2.15 microseconds. The composition of cosmic rays, properties of cosmic ray particles, and the general picture of cosmic ray phenomena are discussed. 36 references.

1549 Absorption of Star-Producing Radiation Under Ice by J B Harding, S Lattimore, T T Li and D H Perkins Nature 163 319-320 (1949) Feb 26 (Letter to the editor)

Measurements of the absorption of the radiation responsible for the nuclear disintegrations observed in photographic emulsions have been made in the atmosphere and under lead. A calculation by George is discussed [Nature 162 333 (1948)] which would indicate a slightly greater range in ice, as compared with air, should be expected. The stars recorded at various ice depths on Ilford C2 emulsions, 100 μ thick, are tabulated; from these data the range of the star-producing radiation in ice was calculated as 1.33 times that in air. This is in fair agreement with the ratio calculated, assuming that the cross-section for star production is proportional to the geometric cross-section of the nucleus; from the range of 200 gm/cm^2 the effective cross-section was determined to be 0.15 barns for an oxygen nucleus. It is thus concluded that the stars are produced by stable particles, their range depending on the atomic weight of the absorber.

1550 Cosmic-Ray Showers Produced in Thick Layers of Lead (Livni kosmicheskikh lucheĭ, obrazuemye v tolstykh sloyakh svintsa) by L N Korablev, A L Lubimov and A V Miller Doklady Akad Nauk SSSR 61 633-635 (1948) Aug 1 (In Russian)

Showers of a special kind were observed in 1945 and 1946 by the expeditions of the Physical Institute of the Academy of Sciences into the Pamir mountains. These showers, produced in thick lead filters by penetrating particles whose number rapidly increases with the altitude, were submitted to a further study in 1947. Among the several methods employed, a hodoscopic design was used by the authors of the present preliminary paper. The path configurations clearly show the difference between δ-showers generated by mesons, which consist of several soft particles produced by a single penetrating one, and the showers under study (temporarily named "special" showers by the members of the expeditions). These latter showers consist of several penetrating particles accompanied by a soft component.

COSMIC RADIATION AND MESONS (continued)

Correlated showers observed outside the Pb walls of the instrument consist mainly of particles coming from the instrument. A "special" shower is formed already under 2-4 cm Pb. Its solid angle is characteristically large. Both charged and neutral particles generate "special" showers. It is very likely that the "local penetrating showers" described by many authors (especially by Janossi) are the "special" showers studied here: the methods used by those authors left unrecorded some of the characteristic features of the phenomenon.

1551 Creation of a "σ" Meson by a Highly Ionizing Nucleus in the Cosmic Radiations by J J Lord and Marcel Schein Science 109 114-115 (1949) Feb 4

A mosaic of photomicrographs which shows an example of an unusual case of the production of a σ-meson in the emulsion of a 11-μ thick boron-loaded Ilford C2 plate is discussed. The plate was exposed to cosmic radiation through the use of free balloons which remained at altitudes corresponding to pressures of 4-6 cm of Hg for 11 hours. The elementary act in which this meson was produced differs from those found by Powell and his collaborators [Occhialini and Powell Nature 162 168 (1948)]. From the mosaic it is concluded that a single particle passing through the emulsion interacts with one of the nuclei in the emulsion to create a meson. The absence of a large nuclear disintegration suggests that the meson was created in a pure nucleon-nucleon interaction. This seems to indicate that nuclei can be highly transparent to the bombardment of stripped nuclei of energies capable of producing a meson.

1552 The Emission of Radiation in the Disintegration of Mesons by Daniel B Feer Phys Rev 75 731-734 (1949) March 1

The probability that a meson of integral spin disintegrates into an electron, a neutrino, and a photon has been calculated. This is essentially a classical process, the radiation being regarded as caused by the acceleration of charge in the disintegration. Because of the classical nature of the problem, the result is independent of the quantum mechanical properties (spin, coupling) of the meson field. For definiteness, the non-radiative decay is taken as being a two-body process in accordance with the original Yukawa theory, but several different types of couplings are used. The quantum mechanical probability for emission of one photon diverges at the low frequency end of the spectrum; this difficulty is avoided by using as a measure of the process the ratio of mean energy emitted to mean energy available for the process per unit time. This is of the order of $e^2/\hbar c$; the energy spectrum also is in agreement with the classical result.

1553 Further Experiments on Cosmic-Ray Bursts by H S Bridge and B Rossi Phys Rev 75 810-818 (1949) March 1 (See also Nuclear Science Abstract I-1804)

The paper describes further results obtained by the observation of coincidences between pulses of a Geiger-Mueller counter tray and of an ionization chamber [Phys Rev 72 257 (1947)]. The experiments were carried out partly aboard a B-29 aircraft and partly on the top of Mt. Evans in Colorado. The main purpose of the experiments at Mt. Evans was an investigation of the "transition curve" in lead. The experimental data are consistent with the assumption that the coincident bursts observed with a lead shield between the Geiger-Mueller tubes and the ionization chamber are mainly produced by cascade showers initiated by electrons and photons either incident upon the lead from the atmosphere or produced in the lead by nuclear interactions. The experiments aboard the B-29 at elevations up to 30,000 ft, furnish information on the variation with altitude of the radiation responsible for the nuclear interactions.

1554 Interaction of Mesons with Nucleons and Light Particles by T D Lee, M Rosenbluth and C N Yang Phys Rev 75 905 (1949) Mar 1 (Letter to the editor)

In the course of a phenomenological study of the various experiments which have been done in recent years on the interaction between the various types of particles, two interesting points have come to light. First, it was found that if the decay of the μ-mesons and the capture of the μ^--mesons by nuclei are described by the reactions $\mu \rightarrow e + \nu + \nu$ $\mu^- + P \rightarrow N + \nu$ and the Fermi type interactions

COSMIC RADIATION AND MESONS (continued)

are assumed to be responsible for these processes, the coupling constants would have the values $g_{\mu e} \sim 3 \times 10^{-48}$ erg cm^3 and $g_{\mu P} \sim 2 \times 10^{-49}$ erg cm^3, respectively. The possibility of explaining the equality of these interactions in a manner analogous to that used for the Coulomb interactions, i.e., by assuming these interactions to be transmitted through an intermediate field with respect to which all particles have the same "charge" is noted. Second, if it is assumed that the π-mesons have integral spin and assume direct couplings for the processes $\pi \rightarrow \mu$ + anti ν $N \rightarrow P + \pi^-$ with coupling constants determined from the lifetime of the π-mesons and the strength of nuclear forces, the interaction between the μ-mesons and the nucleons can be quantitatively explained as a second-order interaction through the virtual creation and annihilation of π-mesons.

1555 Investigation of Genetically Related Pulses by the Method of Proportional Counters (Issledovanie geneticheski sviazannykh tolchkov metodom proportsional'nykh schetchikov) by D Rakitin and G Stashkov Doklady Akad Nauk SSSR 61 263-266 (1948) July 11 (In Russian)

The existence of dense streams of non-ionizing particles producing simultaneous nuclear disintegrations was disscovered in the cosmic radiation by Dobrotin and Tsyrlin [Doklady Akad Nauk SSSR 57 No. 5 (1947)]. In the present work this phenomenon was studied at 3860 m altitude with the aid of a telescope of four groups of proportional counters. The coincidences compared were 1, 2, 3, 4 and 1, 2, 4. It was found that in about 1/3 of all cases discharges in 1, 2, 4 were not accompanied by a discharge in 3. Various devices and modifications in the experimental set up excluded the possibility of attributing the observed phenomenon to the following agents: extensive atmospheric showers, narrow showers of relativistic particles with possible ionization fluctuations, strongly ionizing particles generated through nuclear disintegrations, heavy mesons, electrons or photons. Furthermore, it was shown that the particles responsible for the phenomenon move in narrow streams.

1556 Investigation of Heavy Particles in Cosmic Rays with the Aid of a Proportional Counter (Issledovanie tyazhelykh chastits v kosmicheskikh luchakh pri pomoshchi proportsional'nogo schetchika) by A N Gorbunov and I V Chuvilo Doklady Akad Nauk SSSR 61 1019-1022 (1948) Aug 21 (In Russian)

Using the double proportional counter described in Zhur Eksptl i Teoret Fiz 18 275 (1948), a study of nuclear disintegrations was made at 3860 and 4700 m altitude, which confirmed the conclusion previously reached on the existence in the cosmic radiation of a neutral component made of spontaneously disintegrating particles, i.e., neutral mesons. The effective cross section of absorption in various materials of the penetrating part of the generating component is $\sigma = 0.19(A-Z)^{\frac{1}{3}} \ 10^{-25}$ cm^2. The same double counter was used for determining the relationship between nuclear disintegrations and the "special" showers generated under thick Pb filters, which had been studied by various methods during the expeditions into the Pamir mountains since 1945. The authors' experiments confirmed the presence in these showers of a considerable number of strongly ionizing particles.

1557 Investigations by the Proportional Counter Method of Genetically Related Pulses Produced by Cosmic Rays (Issledovaniya metodom proportsional'nykh schetchikov geneticheski svyazannykh tolchkov, vyzyvaemykh kosmicheskimi luchami) by N Dobrotin, S Nikol'skiĭ and V Tsyrlin Doklady Akad Nauk SSSR 61 249-251 (1948) July 11 (In Russian) (See also Nuclear Science Abstract I-1563)

Genetically correlated coincidences described by the authors in Doklady Akad Nauk SSSR 57 443 (1947) were submitted to a further study at 3860 m, using essentially two groups of proportional counters placed one above the other or both in the same horizonal plane. The small influence of the geometric configuration may be seen by comparing the following figures: 14.7 coincidences were obtained with the superposed counter groups, 11.0 coincidences with the counters in one plane. The correlation coefficients of the amounts of ionization in both groups of counters showed that the phenomenon studied could not be attributed to dense showers of relativistic particles. The characteristic small influence of the geometric configuration of the counters excluded the single strongly

COSMIC RADIATION AND MESONS (continued)

ionizing particles as a possible agent, while experiments with filters between individual counters excluded heavy particles from "stars." These results confirmed the authors' original explanation of the phenomenon as being due to genetically related nuclear disintegrations.

1558 Investigation of Showers under Lead and of Atmospheric Showers at 3860 m Altitude with a Controlled Wilson Chamber (Issledovanie livnei pod svintsom i vozdushnykh livnei na vysote 3860 m metodom upravlyaemoi kamery Wilsona) by N G Birger Doklady Akad Nauk SSSR 61 245-247 (1948) July 11 (In Russian)

Previous work at the same altitude (3860 m) showed the existence, under thick lead filters, of a peculiar shower type which cannot be explained by δ-effects. The authors studied them with a Wilson chamber under 20 cm Pb. The photographs contain showers which must be attributed to mesons (or protons?), and many soft electrons. This simultaneous formation of 2 components, a penetrating one and a soft one, may perhaps be brought into parallel with the production of 2 components by the primary cosmic radiation in the high regions of the atmosphere. One picture showed 3 cases of the formation of heavy ionizing particles by non-ionizing agents. This photograph seems to confirm the hypothesis of genetically related pulses advanced by Dobrotin and Tsyrlin [Doklady Akad Nauk SSSR 57 443 (1947)]. In a second series of experiments atmospheric showers were photographed in the Wilson chamber. Several types were observed: (1) Auger showers; (2) "explosion" showers with a very dense core and a large number of soft electrons formed in the iron base of the chamber; (3) "local" showers similar to those described by Daudin [Ann Phys (Paris) 18 145 and 217 (1943)].

1559 Measurements of the Soft and Hard Components of the Cosmic Radiation with the Aid of a Circular Set-up (Ismereniya myagkoi i zhestkoĭ komponent kosmicheskogo izlucheniya s pomoshch'yu krugovoĭ ustanovki) by S A Azimov Doklady Akad Nauk 61 1005-1008 (1948) Aug 21 (In Russian)

A "circular" set-up was used for the determination of the intensity of the soft component at 900, 3860, and 4700 m altitude. A single small counter (bare or surrounded by a 5 mm Al filter) was placed in the center of a half-circle of larger counters. The ratio soft/hard (without the Al filter) was found to be $44 \pm 5\%$ at 900 m, $111 \pm 5\%$ at 3860 m, and $131 \pm 3\%$ at 4700 m. The number of particles in the interval between 0.6 Mev (threshold set by the counter walls) and 3.5 Mev (threshold set by the Al filter) forms 20-22% of the intensity of the soft component. This value coincides with the fraction (20%) occupied by electrons of these energies in the equilibrium spectrum of electrons in the air, calculated by Tamm and Belen'kiĭ [J Physics USSR 1 177 (1939)]. That part of the soft component which is not in equilibrium is expressed by a ratio soft/hard equal to 25% (at 3860 m altitude); it consists mainly of electrons and photons; it is perhaps identical with the soft component of the so called "special" showers generated at those altitudes by some high energy nucleons.

1560 Meson Masses and the Principle of Reciprocity by Max Born and Antonio E Rodriguez Nature 163 320-321 (1949) Feb 26 (Letter to the editor)

The authors present some numerical results obtained using the theory of elementary particles and quantized fields as applied to the case of mesons, as proposed by Born and Green in two previous letters. Using a recurrence formula to obtain the roots of the Laguerre polynomial equations, the particle mass is found to be $m = b\sqrt{x}/c$ in which a and b are the absolute length and momentum, i.e., $ab = \hbar$. If it is assumed that a is the classical radius of the electron, a mass of approximately 194 electron masses is obtained for the mass of the most stable meson. A figure is shown indicating the masses of the other mesons which are obtained if the same assumption is made. The next most stable meson has a mass of 300 electron masses. These values are in good agreement with the experimental values and the numerous less stable meson masses obtained may explain the experimental spreading of the values obtained by different observers.

COSMIC RADIATION AND MESONS (continued)

1561 Neutrons in the Penetrating Showers of the Cosmic Radiation by G Cocconi, V Tongiorgi-Cocconi and K Greisen. Cornell University nd 5p (NP-642)

An article based on this document has been published in Phys Rev 74 1867-1868 (1948) Dec 15. An abstract of this article appeared in Nuclear Science Abstracts as Abstract No. II-538.

1562 Note on the Slowing Down of Mesons by N F Mott Proc Phys Soc 62 A 136-137 (1949) Feb

The author confirms the formula $\frac{dW}{dt}=\frac{2}{3\pi}\frac{m^2e^4V^2}{\hbar^3}\ln\frac{137v_0}{c}$ which has been given by Fermi, Teller, and Weisskopf [Phys Rev 71 314 (1947)], for the rate of loss of energy of slow mesons passing through a metal. The formula is derived for the case in which V, the meson velocity, is much smaller than v_0, the maximum velocity of the electrons which form the degenerate Fermi gas in the metal. The energy of the electron is represented as W, and m and e refer to its mass and charge, respectively. The result is confirmed by showing that it is identical with that obtained in a problem of the electrical resistance of alloys, for which the application of the same methods has given results in agreement with experiment; if the effect of the lattice field is neglected, the calculations necessary to obtain the following two quantities are identical: (a) the rate dW/dt of loss of energy by a heavy charged particle moving with velocity V through the gas. (b) The rate of loss of energy of an electron gas moving with velocity V past a stationary charged particle (e.g. a proton). The second problem is the same as that of of finding the residual resistance of a metal containing dissolved hydrogen. No experimental results are known for the increase of resistance due to hydrogen in monovalent metals, to which this analysis should be applicable; but the theory agrees well with experiment when applied to calculate the increase of resistance due to the addition of 1% of Ni, Zn, Ga, Ge or As to copper (Mott and Jones, Theory of the Properties of Metals and Alloys, Oxford, Clarendon Press 1936 p.293).

1563 On the Nature of Mesons in Penetrating Showers by H A Meyer, G Schwachheim, A Wataghin and G Wataghin Phys Rev 75 908-909 (1949) Mar 1 (Letter to the editor)

Experiments were performed at an altitude of 1750 meters in order to obtain information on the nature of the particles produced in penetrating showers. Coincidence rate data are tabulated for no material, lead, gasoline, and gasoline and lead. The results are discussed and it is concluded that some of the shower particles produced locally above the counter arrangement are much softer than those of the penetrating showers produced in the atmosphere, the former being absorbed in 28 cm of lead. The experimental results are explained in terms of some recent ideas on the properties of different kinds of mesons.

1564 On the Origin of Cosmic Rays by H Alfven, R D Richtmyer and E Teller Phys Rev 75 892-893 (1949) Mar 1 (Letter to the editor)

The discovery of highly charged nuclei among cosmic rays makes it appear probable that cosmic rays are due to electromagnetic acceleration processes. It is possible that cosmic rays are generated on or in the neighborhood of the sun and are kept near the solar system by extended magnetic fields. These fields could also account for the isotropy and constancy of cosmic rays by repeatedly reflecting and homogenizing the charged particles. It is noted that cosmic ray variations of up to 20% are sometimes observed during magnetic storms and it is suggested that cosmic rays are produced by repeated passages of particles through the storm-producing beams which are emitted from the sun with a very high velocity; the beams are polarized during passage through the solar magnetic field. The electric fields thus produced may accelerate or deccelerate the particles.

1565 On the Showers of Mesons and Nucleons by G Wataghin Phys Rev 75 693 (1949) Feb 15 (Letter to the editor)

Recent experimental results have caused the author to reformulate the fundamental assumptions proposed in previous papers in order to give a quantitative description of the production of mesons [Phys Rev 74 975 (1948)]. The revisions in the earlier theory are outlined and discussed.

COSMIC RADIATION AND MESONS (continued)

1566 The Origin of Neutrons Associated with the Extensive Showers of Cosmic Radiation (Sull'origine dei neutroni associati con gli sciami estesi della radiazione cosmica) by V Tongiorgi Cocconi Nuovo Cimento 5 391-393 (1948) Aug (In Italian) (Letter to the editor)

The presence of neutrons in the extensive atmospheric showers has been discovered with the aid of groups of proportional counters filled with BF_3 (enriched with the isotope B^{10}) and immersed into a paraffin block. A series of experiments performed at sea level consisted in placing one or several filters (paraffin or lead) around this instrument. It was established that the neutrons produced in lead filters were generated there by the particles (mesons or nucleons) forming the penetrating component of the cosmic radiation. The data obtained do not, however, give any direct indications as to the source of neutrons in the atmospheric showers. In the author's opinion, the hard cosmic-ray component, and, more precisely, its nucleonic part, should be considered as the most probable source of neutrons in the atmosphere.

1567 Showers Produced by Photons in a Lead Plate by Albert Simon. University of Rochester Technical Report No. II nd 5p (NP-672)

Calculations were made using the theory of shower processes given by Rossi and Greisen. An electron shower is produced by a photon striking a lead plate. The first calculation gives the total number of electrons produced in a shower as a function of the thickness of the lead plate. This was done for incident proton energies of 20,50 and 150 Mev. The optimum thickness of lead for total electron production is shown graphically. The next calculation was to find the energy spectrum of the emitted electrons. Finally, the average number of electrons with energies between 0 and 7 Mev was calculated. This permits an estimation of an upper limit to the total energy in the shower. The results of this calculation are given. This entire theory holds only for average showers. Fluctuations are not considered.

1568 The Vertical Intensity at 10,000 Feet of Ionizing Particles That Produce Penetrating Showers by W E Hazen, C A Randall and O L Tiffany Phys Rev 75 694-695 (1949) Feb 15 (Letter to the editor)

A large cloud chamber was operated at Echo Lake, Colorado (10,600 ft) for the purpose of measuring the intensity of ionizing particles that produce showers containing penetrating particles and to study the details of the showers. Some estimates based on a preliminary survey of the films, which were made in the field, are given (since the films were destroyed by fire, no detailed study was possible). From the data taken, the intensity of the ionizing, penetrating, shower-producing radiation in that locale is estimated as $1.1 \pm 0.3 \times 10^{-5}$ cm^{-2} sec^{-1} $sterad.^{-1}$ The average absorption path length in air, assuming exponential absorption, is estimated as $80 g/cm^2$. An estimate of the dependence of collision cross section on atomic number can be made from the relative frequencies of production of penetrating showers in the lead and in the aluminum. The data are consistent with an $A^{2/3}$ variation for the cross section.

GEOLOGY AND GEOPHYSICS

1569 Age Determination by Radiocarbon Content: World-Wide Assay of Natural Radiocarbon by W F Libby, E C Anderson and J R Arnold Science 109 227-228 (1949) Mar 4

A world-wide assay of the radiocarbon content of specimens from various locales, as counted in the form of elementary carbon in a screen wall counter, has been made and the results are presented in tabular form. These results establish the world-wide uniformity of the radiocarbon assay at the present time. If it is assumed that this was true of ancient times, then by using the known half-life of radiocarbon, it is possible to calculate the specific activity to be expected after any given time interval elapsed since the removal of any carbonaceous material from equilibrium with the life cycle. Age determinations of several ancient Egyptian samples which were made by measuring their activities are found to be in fairly close agreement with the historically accepted age values, thus corroborating the aforementioned assumption.

GEOLOGY AND GEOPHYSICS (continued)

1570 **Measuring Geologic Time by the Strontium Method** by Louis Ahrens Bull Geol Soc Amer 60 217-264 (1949) Feb

The strontium method for measuring geological age has been examined in each of its aspects, and the general conclusion is made that evidence is now sufficient to show this method as capable of providing reliable age measurements. Of the total strontium in the earth's crust, 0.5-1.0% is considered to be radiogenic, almost all of which is concentrated in potassium and cesium minerals. Lepidolite contains the highest proportion of radiogenic strontium, in which mineral it usually predominates completely. Amazonite, pollucite, hydrothermal permatitic microcline, zinnwaldite, some specimens of lithium-rich muscovite, and probably also rhodizite and lithium-rich biotite commonly contain a high proportion of radiogenic strontium; age measurements may be made on most of these minerals, if not all. Age determinations on other minerals are also possible, and the strontium method could probably be extended to granite biotites, which would increase its scope very considerably. With lepidolite, a reasonably reliable age can be obtained in most instances without an isotope analysis, although one is desirable. An isotope analysis is imperative for age determinations on all other minerals. For a quantitative isotope analysis of strontium, the mass spectrograph is superior in sensitivity and accuracy to other methods; a quantitative analysis can be made on as little as 0.3 mg. of strontium salt, and a conveniently low proportion of radiogenic strontium can be determined in the presence of an excess of common strontium. In all, 32 strontium age determinations are known, 30 of which have been made according to a spectrochemical procedure outlined in this paper. The quantitative determination of Sr/Rb ratios is discussed in some detail. Where comparisons were possible, strontium ages tally reasonably well with lead and helium (magnetite) ages, with few exceptions. 10 fig. 7 tables 57 ref.

HEALTH PROTECTION

1571 **Safe Disposal of Radioactive Wastes Demands Special Training for Sanitary Engineers** by Arthur E Gorman Civil Eng 19 No. 3 29-32 (1949) March

The answers to some of the problems of radioactive waste disposal encountered by the Atomic Energy Commission are discussed. Different methods of disposal, applicable to the different types of wastes produced, are described, The author stresses the need for sanitary engineers with the necessary training in nuclear physics to carry on such work at the various atomic energy installations.

INSTRUMENTS

1572 Direct-Writing Instruments for Radiocardiography by Payne S Harris Science 109 177 (1949) Feb 18

This is a brief description of a direct-writing instrument devised by the author. It has been published because he had not been able to find in any article, or in conversation with members of the Instrumentation Branch of AEC, adequate descriptions of such apparatus.

1573 An Electronic Differential Analyzer by A B MacNee. MIT Research Laboratory of Electronics Technical Report No. 90 Dec 16 1948 44p (NP-643)

An electronic differential analyzer capable of solving ordinary differential equations of orders through the sixth, both linear and nonlinear, is described. This analyzer has a high speed of operation and is extremely flexible with regard to equation parameters and initial conditions. This flexibility permits rapid investigation of wide ranges of equation solutions with regard to periodicity, instability, and discontinuities. It renders practicable the solution of end point boundary-value problems, that is, problems in which the final rather than initial values are specified. Two new computing elements, an electronic function generator and an electronic multiplier, are employed in this differential analyzer. A diode clamping circuit permits the use of a-c coupled amplifiers. A number of representative differential equations of the linear and nonlinear types have been solved. Comparison of observed and calculated solutions reveals an accuracy of from 1 to 5 per cent, while the precision (or repeatibility) of the solutions ranges from 0.002 to 0.1 per cent. An analysis of the errors introduced into the differential-equation solutions by the frequency limitations of the computing elements, such as the integrators and adders, has been made, and the results of this analysis have been verified experimentally.

1574 Instructions for the Use of the Cascade Impactor by K R May. PTN-1600 Apr 1 1944 19p

This paper contains a description of the Cascade Impactor followed by an account of the technique employable with this instrument. The latter comprises sections on the treatment of the glass sampling plates and on the analysis of the samples obtained. The Cascade Impactor was designed primarily for quantitative and qualitative sampling of windborne clouds of solid and liquid particles in the size range 1-200 μ, the wind speed being of the order of 8 mph. It will, however, also deal with stationary clouds. The greatest efficiency in sampling droplets of unit density is achieved in the range from approximately 1.6-50 μ. The instrument might be usefully applied in sampling such aerosols as fogs, atomizer and insecticide sprays, coarse industrial and mine dusts, etc. To operate the impactor a source of suction such as an injector or motor driven pump is required. A sampling rate of 17.5 liters/min. has been adopted as standard, that being the highest which can reasonably be expected from a small type of injector when working against the pressure drop (20 cm water at 17.5 liters/min.) of the instrument.

1575 A Portable Optical Instrument for the Measurement of Particle Size in Smokes by V K LaMer and David Sinclair. Office of Scientific Research and Development Report OSRD-1668 Aug 3 1943 33p

A portable optical instrument, code name, the "Owl," has been designed and used for field, observations of smoke particle radii from 0.10 to 1.0 microns. The smoke (or fog) must be moderately homogeneous as to particle size and the particles approximately spherical in shape and transparent (non-absorbing).

Particle radii from 0.10 microns up to 0.20 microns are determined with an accuracy of about 0.02 microns by measurement of the polarization of the light scattered at right angles. Radii from 0.2 up to 1.0 microns are determined with an accuracy of about 0.05 microns by counting the number of spectra in the scattered light (described by LaMer and Sinclair in Division B report, Serial No. 57, 1941). The method of measurement of the polarization of the scattered light is described. Calibration curves are provided for several indexes of refraction: 1.33, 1.44, 1.50, 1.55, and 2.0. Instructions and precautions for the operation of the instrument are given. Details of construction and diagrams of the

INSTRUMENTS (continued)

instrument in its present form are described and a list of parts included. Several replicas of improved design have been constructed. A discussion of the sources of error is included.

1576 A Radon Purification Apparatus by H C Sutton Brit J Radiology 22 164-168 (1949) Mar

An apparatus is described for the routine purification of radon. The purification is by physical means as far as possible, and the apparatus is designed to miminize time of operation and general danger to the operator. As regards yield, purity, and radiation exposure, the plant compares favorably with others.

1577 A Sensitive Photoelectric Smoke Penetrometer by F T Gucker Jr, H B Pickard and C T O'Konski. Office of Scientific Research and Development Report OSRD-5499 July 30 1945 31p

The Northwestern Photoelectric Penetrometer E1R2 was designed to meet the demand for a direct-reading laboratory instrument to measure the smoke penetration of the modern improved filters. The transmission of these filters, which is only one or two hundredths of one percent of a standard DOP smoke, is considerably below the range in which visual comparison of the intensities of scattered light is feasible; hence, a photoelectric cell was used. The unit was made sufficiently compact to be portable, with the electrical circuits as simple as possible to minimize the initial cost and to facilitate operating technique and maintenance.

In outline, the operation of the instrument is as follows: Smoke is passed through a cell traversed by an intense beam of light. A portion of the light, scattered at approximately 90°, falls on a vacuum phototube and the resulting photoelectric current is measured potentiometrically. The scale of the instrument is set on 100% penetration when unfiltered smoke is passed through the cell, and the percent penetration of a filter is read directly when the filtered smoke is passed through the cell.

1578 A Theoretical Comparison of the Performance of Stationary-Target Crystallographic X-Ray Tubes Operating on Alternating and Direct Voltages by R Witty and P Wood Nature 163 323-324 (1949) Feb 16 (Letter to the editor)

Theoretical calculations which were made for a normally self-rectifying crystallographic X-ray tube are summarized. The X-ray intensity curves obtained show that, for a constant power input, and working at the usual voltage, the theoretical increase in intensity produced by substituting D.C. for A.C., is about 18%. This, combined with the possibility of a 20% increase in the power input using D.C., results in a total increase in intensity of approximately 40%. It is therefore concluded that the increase in intensity obtained by operating a stationary target X-ray tube on a D.C. high-tension supply as opposed to an A.C. supply, although advantageous in itself, is considerably outweighed by the additional expense and maintenance of a D.C. supply. The ratio of characteristic radiation to white radiation, referred to here as contrast, is practically unchanged.

ISOTOPES

1579 The Measurement of Stable Isotope Abundance Ratios by Eric R Roberts Analyst 73 657-660 (1948) Dec

The measurement of stable isotope abundance ratios by methods other than the mass spectrometer is desirable owing to the high initial cost and operating skill required for the latter. Alternative methods are described which, although incapable of as high a degree of accuracy, are relatively cheap to initiate and require skills within the realm of the chemist. Such methods may be concerned with the measurement of those properties which depend on mass, and in practice have been confined mainly to comparative determinations of density (gases and liquids) and thermal conductivity (gases), although in some early work on heavy water the refractive index was used. It is noted that such methods may require exceptional care in the chemical purification of samples. 13 references.

ISOTOPES SEPARATION

1580 The Separation of the Oxygen Isotopes by Thermal Diffusion by R H Davies Trans Faraday Soc 45 145-148 (1949) Feb

The results given by Lauder [Trans Faraday Soc 43 620 (1947)] for the separation of oxygen isotopes in a thermal diffusion column are extended to take account of the O^{17} atoms. The calculations made indicate that the efficiency of the columns is approximately that predicted by the theory of Furry, Jones, and Onsager [Phys Rev 55 1083 (1939)].

MASS SPECTROGRAPHY

1581 The Mass Spectrometer and Some Chemical Applications by J Kistemaker Analyt Chim Acta 2 522-531 (1948) Dec

The use of the mass spectrometer as a tool in analytical chemistry is discussed. A schematic description is given of the spectrometer and of the various recording systems. The following simple chemical applications are mentioned: (1) General gas control in continuous processes; (2) Analysis of organic gases and vapors; (3) Purity control; (4) Determination of ionization and dissociation energies.

METALS AND METALLURGY

1582 Metallographic Examination of Beryllium Alloys by M C Udy, George K Manning, and L W Eastwood. AECD-2553 April 1948 Decl Jan 10 1949 23p

A metallographic technique has been developed for beryllium and beryllium-rich alloys. The following phases have been identified: carbide, nitride, aluminum rich, silicon rich, calcium rich, titanium rich, tin rich, iron rich, manganese rich, boron rich, molybdenum rich and uranium rich. No second phase attributable to copper could be found in a 6 per cent copper alloy. No second phase attributable to magnesium could be found in a 40 per cent magnesium alloy. No phase attributable to oxygen or hydrogen has been found. This does not preclude their presence in liquid or solid solutions. Color transparencies have been prepared of a number of microstructures. These will be available for loan to AEC laboratories on request.

1583 Arc Melting of Titanium by O W Simmons, C T Greenidge and L W Eastwood Metal Progress 55 197-200 (1949) Feb

An arc melting furnace of 1-lb capacity is completely described and the production of a typical heat is discussed. A diagram of a new design for an arc-melting furnace (capacity 5 lbs.) is presented. The arc furnace is well suited to the rapid production of small ingots of titanium or other refractory alloys without contamination from the atmosphere or from the crucible material. Iodide titanium can be melted in furnaces of the type described with little or no increase in hardness, indicating that contamination during the melting operation is negligible. The nitrogen content of ingots of unalloyed process A titanium has been repeatedly shown to lie in the range of 0.010 to 0.015%, values which are only slightly greater than that of the unmelted process A sponge.

1584 The Consolidation of Titanium Powder by Sheath Rolling by J R Long Metal Progress 55 191-192 (1949) Feb

The production of titanium in large pieces is accomplished by "sheath rolling." This new method consists of sealing the titanium powder in metal containers and rolling the assembly at elevated temperatures. Titanium, sheath rolled, is dense, sound, and ductile. It can be cold worked. A table giving some mechanical properties of standard titanium sheet produced by pressing and sintering and sheet produced by sheath rolling is included along with photomicrographs.

1585 Induction Melting and Casting of Titanium Alloys by P H Brace Metal Progress 55 196-197 (1949) Feb

Titanium alloys are melted in thoria crucibles. The crucibles are cylindrical molybdenum capsules with a lining of thorium oxide electrically fused. Diagrams of the vacuum melting crucible and mold are shown and the operation of the equipment is discussed.

METALS AND METALLURGY (continued)

1586 Induction Melting of Titanium in Graphite by J B Sutton and T D McKinley Metal Progress 55 195 (1949) Feb

The equipment and method of producing 10 lb ingots is described. The ingots contain 0.4 to 0.7% carbon and 99.0% titanium; the remainder is minor impurities present in the 99.5% titanium sponge used in the charge. The hardness of the ingots vary from a little below 200 to 240 Vickers.

1587 Liquid Metal Heat Transfer Fluid by J L Everhart. American Smelting and Refining Company Nov 24 1948 68p (NP-684)

A compilation of graphic and tabular data from a literature search on melting points and other properties of alloys for a liquid metal heat transfer medium is presented. 249 references.

1588 Physical Chemistry of Gallium-Indium Alloys by J Hugh Hamilton, John R Lewis and J P Denny. University of Utah Department of Metallurgy Annual Technical Report Oct 1 1947 - Sept 30 1948 64p (NP-645)

Certain gallium-lead, gallium-lead-bismuth, and gallium-indium compositions have been studied, with particular emphasis on the low melting alloys. The work has included thermal, chemical and metallographic analyses. Experimental evidence shows rather conclusively that no gallium-lead-bismuth compositions are molten at room temperatures. This is attributed to limited solubility of lead-bismuth alloys in liquid gallium, at the gallium melting point. Eutectic temperatures indicated are Ga-Pb, 29.4°C and Ga-Pb-Bi, 27.5°C. A method is developed for rapid determination of the gallium-indium eutectic composition. This consists in effecting a separation of the eutectic by centrifuging temperatures just above the eutectic temperature, and conducting chemical analyses on the separated constituents. Techniques developed to date, applicable to the study of low melting alloys, are discussed. 22 references.

1589 The Production of Titanium by the Iodide Process by Bruce W Gonser Metal Progress 55 193-194 (1949) Feb

The production of titanium by the iodide process is described. The equipment, its operation, power consumption and type of product are discussed.

1590 Production of Titanium Powder by the Bureau of Mines by F S Wartman Metal Progress 55 188-190 (1949) Feb

The Bureau of Mines is conducting experiments on the Kroll process for producing titanium. The process is described in detail and a discussion of impurities is included.

1591 Specific Heat of Beryllium between 0° and 900°C by D C Ginnings, T B Douglas and Anne F Ball. National Bureau of Standards Report NBS-5 Mar 3 1949 7p

The sample whose specific heat was being measured was held in a thermostated furnace until temperature equilibrium was attained, and was then dropped into a Bunsen ice calorimeter, which measured the heat given up by the sample when it cools to 0°C. From these enthalpy values of the sample, so determined for a series of temperatures, the specific heat was evaluated by conventional methods. The sample of beryllium (3.6 grams) was sealed in a Nichrome capsule. Two series of experiments were made to account for the heat capacity of the capsule, one series with the empty capsule, and another with the capsule containing the sample. These two series were made at identical temperatures. A total of 90 experiments were made, 39 with the empty capsule and 51 with the capsule and sample. The heat capacity of the sample was about twice as large as that of the capsule. The average deviation from the mean at any one temperature was about 0.06% in the experiments with the empty capsule and about 0.04% with the experiments with the sample. The estimated uncertainty of results and comparison with results of other workers are included. 12 references.

METALS AND METALLURGY (continued)

1592 The Titanium Program of the Naval Research Laboratory by E J Chapin Metal Progress 55 188 (1949) Feb

The titanium research program of the Naval Research Laboratory is outlined. The laboratory has developed an induction furnace with a capacity of 3 lb. which will operate satisfactorily at a vacuum of 0.001 μ Hg up to 4000°F.

1593 The Titanium Program of the Navy Bureau of Aeronautics by N E Promisel Metal Progress 55 186 (1949) Feb

The mechanical properties of titanium are presented and its excellent corrosion resistance to chlorides is mentioned. The substitution of titanium for several metallic materials is cited and reasons for changing are presented.

MINERALOGY AND MINERAL RESOURCES

1594 Determination of Beryllium in Silicate Rocks by E B Sandell Analyt Chim Acta 3 89-94 (1949) Jan

An improved method for the determination of traces of beryllium in silicate rocks is described, which can be applied to subsilicic as well as silicic types. Beryllium is separated, together with aluminum, from calcium, magnesium, manganese, and iron by ammonia precipitation in the presence of mercaptoacetic acid to keep iron in solution. The beryllium in the precipitate is brought into solution, and separated from titanium and small amounts of iron, and possible other coprecipitated metals, by double fusion with sodium hydroxide. The final determination of beryllium is made fluorimetrically with morin.

1595 The Polarographic Method for Determining Trace Elements in Rocks and Minerals by Esther W Claffy Amer J Science 247 187-199 (1949) March

Polarographic analysis is based on the measurement of current developed in a solution contained in an electrolytic cell with a dropping mercury electrode. The magnitude of the current is proportional to the concentration of the element, and its measurement establishes quantitative determination. Identification of the element is made from the "half-wave potential," each electro-reducible or electro-oxidizabe substance having a characteristic value. The method is particularly suitable for quantitative analysis of amount in the range of 10^{-2}M to 10^{-6}M (about .X% to .000X%), for many metals and non-metals occurring in rocks and minerals. Usually, not more than 3 or 4 elements are determined simultaneously with the polarograph. In many cases, determinations can be made in the presence of other elements, which by ordinary chemical methods are impossible or impractical. Determination of many major constituents can also be made, although with less accuracy, thus permitting a quick, simple, and approximate analytical method suitable for broad surveys. Included in the 40 elements (approximately) to which this method is applicable, are the following: Ra, Ti, Zr, V, Cb, U, and Ge.

NEUTRONS

1596 Inelastic Scattering of Lead for 14.5 Mev Neutrons by H T Gittings, G G Everhart and H H Barschall. AECD-2533 (LADC-646) nd Decl Mar 16 1949 4p Proposed for publication in Phys Rev

Relatively monoenergetic 14.5 $\pm$ 0.5 Mev neutrons were obtained by bombarding a tritium gas target with deuterons from the Los Alamos electrostatic generator. Lead spheres, with internal foil detectors of aluminium and copper, were placed in the neutron beam for 10 minutes and the induced foil activity counted. The inelastic scattering cross section of lead was determined as 2.20 $\pm$ 0.17 barns with the aluminum detector, and 2.29 $\pm$ 0.12 barns with the copper detector. From data for the Cu^{63} (n,2n) threshold (11 Mev), it appears that a 14-Mev neutron loses over 11 Mev in its first inelastic collision in lead. The results agree with that of other investigators [Grahame and Seaborg, Phy Rev 53 795 (1933); Soltan, Nature 142 252 (1938); Amaldi et als, Fundamental Particles, p. 97, London, Physical Society, 1947].

NEUTRONS (continued)

1597 Approximate Calculations of the Neutron Flux From a Plane Source in an Infinite Medium Where the Nuclear Cross Sections Vary with the Energy and with the Distance from the Source, For Energies Above 5 Mev by F H Murray. AECD-2538 (ORNL-218) Dec 3 1948 Decl Mar 18 1949 11p For publication in NNES

Numerous approximate solutions of the Boltzmann equation for the problem have been worked out under explicite assumptions such as the assumption that the energy loss in elastic scattering from a heavy element may be neglected, and that certain elements may be considered as pure scatterers, etc. When the spectral energy distribution of the source is given, these assumptions require examination, it appears in numerous cases that corrections need to be made resulting from the variable source distribution, as well as from the variable cross sections of some materials. The Boltzmann integro-differential equation for the problem can, however, be transformed into a differential equation as soon as good estimates can be made concerning the energy dependence of the unknown functions under the integral sign. Each estimate leads to an evaluation of certain weighting factors (h_{rs}) such that each integral containing an unknown function (f) is replaced by some expression ($h_{rs}f$). In a large class of problems, a few successive approximations are sufficient to determine the energy dependence of the unknown functions, with fair accuracy; it then becomes possible to apply some of the familiar methods of solution of a system of differential equations. In the following analysis for a restricted high energy range, inelastic scattering from heavy elements is assumed equivalent to absorption; but the analysis can be extended without difficulty to include an exact calculation for this type of scattering. Equations are derived for the transformation of the Boltzmann equation with the aid of weighing coefficients, a method of successive approximations for determining the weighing factors and the function p(z, u) is given, and a first approximation equation is derived for the case when hydrogen is present.

1598 The $Cu^{63}(n,2n)Cu^{62}$ Cross Section as a Function of Neutron Energy near the Threshold by J L Fowler and J M Slye. AECU-156 (LADC-644) nd 1p

This document is in abstract form; it is reproduced below in its entirety.

Using the $D(d,n)He^3$ reaction produced by 10 Mev deuterons to give neutrons, the Cu^{63} (n,2n) Cu^{62} reaction has been studied in the vicinity of the threshold. The energy of the bombarding deuterons is determined by magnetic deflection. This, together with the angle which the neutrons make with the beam, gives the neutron energy. The experiment consists of activating copper foils placed about a deuterium gas target which is bombarded by a monitored deuteron beam. The foils are then counted in cylindrical glass-walled Geiger counters. The product of the differential cross section of the $D(d,n)He^3$ reaction and the activation cross section of the $Cu^{63}(n,2n)Cu^{62}$ reaction is obtained as a function of angle to the deuteron beam. By calibrating the Geiger counters with the beta particles from Cu^{66} produced in a known flux of thermal neutrons the data is made absolute in terms of the known thermal capture cross section of Cu^{65}. Previous measurements of the differential cross section of the $D(d,n)He^3$ [Erickson, Fowler and Stovall, Phys Rev 75 (1949) Mar 1] reaction allow the $Cu^{63}(n,2n)Cu^{62}$ cross section to be given as a function of energy.

1599 The Chain $_{56}Ba^{130}(n,\gamma)_{56}Ba^{131} \rightarrow {}_{55}Cs^{131} \rightarrow {}_{54}Xe^{131}$ by L Yaffe, M Kirsch, S Standil and Jean M Grunlund Phys Rev 75 699-700 (1949) Feb 15 (Letter to the editor)

During the course of the neutron irradiation of barium, the following chain was studied: Ba^{130} (n,γ) $Ba^{131} \rightarrow Cs^{131} \rightarrow Xe^{131}$. The half-life was measured over a period of 6 half-lives and found to be 9.6 ± 0.1 days by the method of least squares; the decay curve is shown. Assuming that the softer radiation may be treated as though it were similar to a continuous spectrum of β^--radiation, the energy has been determined by back-scattering [Yaffe and Justus, Phys Rev 73 1400 (1948)] and found to be 115 Kev. The harder component has a half-thickness of 700 mg/cm^2 and is identical with the 31-Kev X-ray found by Katcoff [Phys Rev 72 1160 (1947)]. Assuming that the Cs^{131} γ-ray is 97% converted, the cross section for neutron capture of Ba^{130} has been found to be 24 ± 8 millibarns.

NEUTRONS (continued)

1600 A Cloud-Chamber Study of the Disintegration of Lithium by Slow Neutrons by J K Boggild and L Minnhagen Phys Rev 75 782-785 (1949) March 1

The ranges of tritons and α-particles formed in the slow neutron reaction $Li^6(n,\alpha)H^3$ have been measured in a cloud chamber and found to be $R_\alpha = 10.4 \pm 0.2$ mm and $R_{3H} = 60.0 \pm 0.6$ mm in air at N.T.P.; the corresponding Q values, derived from the blue-printed Cornell energy vs. range curves, disagree, and the Q derived by the proton relation is also in disagreement with other data. The discrepancies suggest the establishment of a new point on the proton energy vs. range curve, viz., $R_p = 20.0$ mm, $E_p = 0.88$ Mev, which means a reduction of the energy by about 6%.

1601 Neutron Absorption in Black Sphere of Particular Intermediate Size by R F Johnston and I L Wilson. National Research Council of Canada Report CRE-406 Dec 1948 16p

The distribution of neutron density in an infinite scattering-medium surrounding a completely absorbing sphere is determined by a graphical-numerical method for the particular case, where the absorber radius is 0.6 measured in mean free paths of the surrounding medium. The treatment is for monokinetic neutrons with isotropic scattering and no capture outside the sphere. The neutron absorption of the sphere is also determined.

1602 Neutron Distributions in Elementary Diffusion Theory by Philip R Wallace Nucleonics 4 No. 2, 30-35 and No. 3, 48-67 (1949) Feb and Mar

This paper, which is a condensation of a recent report written for the National Research Council of Canada, is concerned with the principles of reactor design. The solutions to a selection of standard problems of neutron diffusion in a single medium obtained on the basis of elementary theory are presented in systematic form. The following forms of media and source types are considered: 1. Infinite medium, planar distributions; 2. Infinite medium, spherical distributions; 3. Semi-infinite medium; 4. Slab of finite thickness and infinite extent; 5. Sphere; 6. Sphere with a concentric cavity; 7. Infinite "pile" of rectangular cross-section; 8. Finite "pile" (parallelpiped); 9. Cylinder. The types of diffusion problems considered are: 1. The thermal neutron distribution arising from given thermal neutron sources. 2. The distribution of fast neutrons, as a function of position and energy (or alternatively, "age"). In particular this gives the spatial distribution of thermal neutron sources. (The author considers neutrons as "thermal" and of effectively uniform energy after they pass below a certain threshold energy). 3. The thermal neutron distribution resulting from a given distribution of fast neutrons. (This involves combining solutions from 1 and 2.) The above refer to neutron diffusion in nonmultiplying media; in addition the following is treated: 4. Thermal and fast neutron distributions in multiplying media. The equations and graphs which have been plotted are arranged in outline form and the results given are adequate for the majority of cases which arise in the design of thermal reactors, which are of interest in power generation. An index to all the notation used is given in an appendix. 39 graphs.

1603 Neutron-Proton and Neutron-Neutron Scattering at High Energies by F Rohrlich and J Eisenstein Phys Rev 75 705-724 (1949) March 1

The phase method and the Born approximation are used to calculate the cross sections of high energy neutrons scattered by protons and neutrons. Various exchange theories are considered for both, central and tensor forces of rectangular and Yukawa well shape. For the tensor case the phase method leads to general formulas for the differential and total cross sections in terms of real phase shifts. The reality of the phase shifts is a direct consequence of the use of the asymptotic form of the eigenfunctions of the tensor force Hamiltonian. The differential cross section in this case also contains the "amounts of admixture" which measure the coupling of states of different orbital angular momentum which have the same parity. The real phase shifts and the amounts of admixture are derived from a variational principle. The total cross sections thus obtained are within a few percent of the exact values. The Born approximation is not satisfactory at 100 Mev.

At this energy, tensor forces of a rectangular well shape with Rarita-Schwinger constants yield 0.2113, 0.1497, and 0.1271 barns for the n-p cross section, and 0.2566, 0.1381, and 0.0359 barns for

NEUTRONS (continued)

the n-n cross section, in the neutral, charged, and symmetrical exchange theory, respectively. The observed n-p cross section at 90 Mev, 0.083 ± 0.004 barns, agrees best with the theoretical value of ~0.080 barns at 100 Mev, derived from a tensor interaction potential of equal amounts of neutral and charged exchange. It is concluded, however, that a Yukawa tensor potential of the symmetrical exchange type can be in agreement with the experiments, if relativistic corrections of the n-p cross section at 100 Mev are negative and of the order of 5-10%. The differential cross section needs considerably larger corrections unless a different tensor force range is used.

1604 On the Absorption of Slow Neutrons by Rhodium by Robert R Meijer Phys Rev 75 773-781 (1949) March 1

The absorption of neutrons in rhodium as a function of their time of flight was studied with the Cornell slow neutron velocity spectrometer in the energy range of 0.0044 to 330 ev. A resonance was observed at an energy of 1.21 ± 0.02 ev. No other resonances were observed. Values of the Breit-Wigner parameters [Phys Rev 49 519 (1936)], which best seem to fit the experimental results for a resonance energy of 1.21 ev, are 2750 ± 200 barns for the cross section at resonance (σ_r) and 0.21 ± 0.01 ev for the level width (Γ). The Breit-Wigner formula fits the experimental data in the low energy region. The coefficient of the 1/v term is 0.295 ± 0.005 barn/μsec/m and the constant term (taken as the scattering cross section) is 6 ± 2 barns. Values for the strength of the resonance ($\sigma_r\Gamma^2$) were computed from the minimum cross section on the low energy side of the resonance, from the 1/v slope, from an activity plot, and from the chosen Breit-Wigner parameters. The average of these values of $\sigma_r\Gamma^2$ is 117 ± 8 barn-ev^2. Self-absorption measurements were made to check the results of the time-of-flight measurements. The resonance cross section obtained from the self-absorption measurements is 3120 ± 50 barns, which is in closer agreement with the results of the spectrometer measurements than with those of previous investigators.

1605 On the Space Distribution of Slow Neutrons by G C Wick Phys Rev 75 738-756 (1949) March 1

The behavior of the neutron density about a plane- or point-source of fast neutrons within a homogeneous "slowing down" medium has been re-investigated [Verde and Wick, Phys Rev 71 852 (1947)]. For the case of constant mean free path a known analytical expression for the neutron density has been reduced to a form, which is valid for slow neutrons and for any distance from the source. The feasibility of a numerical evaluation of the formula is demonstrated for M = 1 (hydrogen). In particular, the asymptotic behavior at very large distances has been studied. For the more realistic example of a medium in which the mean free path decreases with decreasing energy of the neutrons, formulas are presented describing the asymptotic density and the asymptotic energy spectrum at large distances from the source.

1606 The Rigorous Calculation of the Neutron "Braking Distances" (Die strenge Berechnung von Neutronen-Bremslängen) by W Bothe Ann Physik 3 52-61 (1948) Aug (In German)

The theory of the "braking distance" of neutrons is developed by taking the coupling between the individual scattering angles and the individual energy losses involved into consideration. This, in general, results in rather unwieldy formulas for the braking distance. A series expression and an integral expression are given. Simple and direct expressions are derived for the initial value of the braking distance, for the braking distance in hydrogen, and for the asymptotic course of the braking distance in the case of strong braking. If the particular collision is elastic and isotropic in the center-of-gravity system, the aforementioned coupling action is in the nature of an increase in the braking distance. The relative influence of the coupling, however, diminishes asymptotically as the stopping increases. Generally, with strong stopping, the braking effects an increase or decrease in the stopping range, depending upon whether $\overline{c\xi} \mid \overline{c}\,\overline{\xi}$ is less or greater than unity. (C is the deviation cosine and ξ is the logarithmic energy loss with a single collision. With $c(\xi)$ = constant, the previous results for the case of no coupling are again obtained.

NEUTRONS (continued)

1607 Search for Nuclear Isomers with Half-Lives between a Millisecond and a Second by J E R Holmes, J Y Mei and R S Turgel Phys Rev 75 889 (1949) Mar 1 (Letter to the editor)

A search has been made for short-lived isomers with half-lives in the range of 10^{-3} to 1 sec using a rotating wheel method similar to that employed by Nahmias and Walen [J Phys et Radium 8 153 (1937)]. The sample was irradiated with slow neutrons from a 230-mc Ra-Be source. The least cross section of formation of an isomer required to detect the isomer was of the order of 5 or 10 x 10^{-24} cm^2. Therefore, the search had to be restricted to elements having fairly large slow neutron capture cross sections. In the 16 elements examined (Li, B, Cl, Ni, Cu, Rh, Ag, Cd, In, Sm, Eu, Gd, Dy, Ir, Au, Hg) no isomers were found. It is noted that this method applies only to metastable states formed as the immediate consequence of slow-neutron capture.

1608 Thresholds for Fast Neutron Fission in Thorium and Uranium by W E Shoupp and J E Hill Phys Rev 75 785-789 (1949) March 1

The threshold energy for fast neutron fission of thorium and uranium has been measured by using the neutrons from thin lithium films through the $Li^7(p,n)$ reaction. Neutron energy fission thresholds were found to be 1.0 ± 0.1 Mev for U^{238} and 1.10 ± 0.05 Mev for Th^{232}.

NUCLEAR PROPERTIES

1609 Energy Levels in Sulfur Nuclei by Perry W Davison Phys Rev 75 757-766 (1949) March 1

A study has been made of the proton groups from the reaction of 3.22-Mev deuterons with sulfur in the form, primarily, of H_2S gas. The following Q values have been assigned to the reaction S^{32}(dp) S^{33}: 6.48, 5.69, 4.58, 4.31, 3.63, 3.33, 2.60, 2.33, 2.06, 1.78, 1.37, 0.85, and 0.18 Mev, corresponding to the ground state and 12 excited states of S^{33}. Four of these groups have been investigated for proton γ-ray coincidences to confirm this assignment. The yield as a function of deuteron energy has been observed for the 6 highest energy groups and indication of the presence of some broad resonances found. A qualitative measurement of the variation with angle of relative yields of the groups has indicated a proton intensity distribution that is symmetric for some groups and asymmetric for others. The cross section for the reaction for 90° observation has been found to be 1.2 barns. The mass difference S^{33}-S^{32} has been calculated to be 0.99963 mass unit.

Two low intensity, high energy groups have been assigned to the reaction S^{33}(dp)S^{34} with Q values of 8.67 and 7.85 Mev. This, together with the above observation, leads to a value of 1.99691 for the mass difference S^{34}-S^{32}.

1610 Measurement of the Proton Moment in Absolute Units by Harold A Thomas, Raymond L. Driscoll and John A Hipple Phys Rev 75 902-903 (1949) Mar 1 (Letter to the editor)

The absolute value of the magnetic moment of the proton has been determined by measuring the magnetic field and frequency required for nuclear resonance absorption in a proton sample. The nuclear resonance technique is similar to that developed by Purcell [Phys Rev 73 679 (1948)] and his collaborators but has a modified circuit design. The sample is water with the relaxation time adjusted to an optimum value by the addition of ferric oxalate. An electromagnet having auxiliary coils in addition to the main exciting windings was used to produce a field of about 5000 gauss. Field variations throughout the volume used did not exceed one part in 10,000 and they were accurately plotted. The accuracy of the measurement of the field was about one part in 20,000. The values of field and frequency thus measured give a value for the gyromagnetic ratio of the proton of γ_p = (2.6752 ± 0.0002) x 10^4. The magnetic moment of the proton was determined to be: μ_p = (1.4100 ± 0.0003) x 10^{-23} gauss cm^3.

1611 On the Nuclear Electric Quadrupole Moment of Li^6 by P Kusch Phys Rev 75 887-888 (1949) Mar 1 (Letter to the editor)

The spectra of all the lithium halides have been observed at a field of about 11,000 gauss. At this field the Li^7 line occurs at a frequency of about 9.6 mc/sec and all second- and higher order terms

NUCLEAR PROPERTIES (continued)

in the quadrupole interaction energy may be ignored. The line of Li^7 in all of the lithium halides shows the characteristic structure predicted by Feld and Lamb [Phys Rev 67 15 (1945)]. Three peaks occur, and the frequency separation of the two extreme peaks is given for the case of the four lithium halides in tabular form. The width of the central maximum, which is a measure of the interaction of the nuclear moment with the magnetic field of the molecular rotation, is also given. It is to emphasized that no experimental evidence exists that the quadrupole moment of Li^6 is other than zero. Theoretical calculations from the appropriate mixture of wave functions enabled the calculation of the quadrupole moments of the Li^7 and Li^6 nuclei which were determined, respectively, as $Q_7 = -2.0 \times 10^{-26} cm^2$ and $Q_6 \leq \pm 0.88 \times 10^{-7} cm^2$. Evidently since the quadrupole moment of Li^6 is at most one-third as great as that of the deuteron, the Li^6 nucleus is in very nearly a pure S state.

1612 On the Stability of the Isobaric Pair $In^{115} - Sn^{115}$ by M Gurevitch Phys Rev 75 767-772 (1949) March 1

A method employing a modified Schuler tube for the excitation of the spectral lines of milligram quantities of material is discussed. The spin of Sn^{115} is found to be one-half, and the stability of the pair $In^{115} - Sn^{115}$ to the nuclear transition $In^{115} - Sn^{115}$ is highly forbidden on the basis of a spin change of four.

NUCLEAR TRANSFORMATION

1613 Characteristics of Bismuth Fission with High Energy Particles by Robert H Goeckermann. AECD-2534 (UCRL-251) Dec 14 1948 Decl Mar 18 1949 68p (See also AECD-1783)

A study has been made of the characteristics of the fission induced in bismuth by irradiation with the high energy deuterons and alphas from the Berkeley 184-inch frequency-modulated cyclotron, using radiochemical methods for the determination of yields of the fission products. The fission yield curve resulting from 190 Mev deuteron fission of bismuth was found to be a single symmetrical peak with a maximum of 5.0 percent at a mass number of approximately 100. The ratio of neutrons to protons was observed to be nearly constant for all nuclides formed in relatively good yield. A survey of the effect of varying the bombardment energy indicated that the fission remains predominantly symmetrical, although the mechanism and the height of the maximum change. The excitation function of the Mo^{99} yield in two lead samples enriched, respectively, in Pb^{204} and Pb^{208} showed that the fission cross section is larger and decreases less rapidly as the deuteron energy decreases in the lead sample which has a higher proportion of the light isotopes. A survey of the fissionability of bismuth, lead, thallium, platinum, and tantalum, irradiated with 380 Mev alphas, showed that the fission cross section decreased by a factor of approximately 1000 from bismuth to tantalum. A mechanism has been postulated for the nuclear reaction, which involves prior neutron evaporation from the initial highly excited nucleus followed by fission with unchanged charge distribution. This document is a revision and amplification of AECD-1783.

1614 Products of the Deuteron and Helium Ion Bombardments of Pa^{231} by D W Osborne, R C Thompson and Q Van Winkle. AECD-2539 (ANL-JJK-14B-172) Dec 1948 Decl Mar 16 1949 8p For publication in NNES

Pa^{231} was bombarded with helium ions (maximum energy 42 Mev) and deuterons (maximum energy 21 Mev) in the Berkeley 60-inch cyclotron. The U and Pa fractions were isolated chemically from the deuteron-irradiated material, and the Np, U, and Pa fractions from the helium ion-irradiated material. Aliquots of the fractions were evaporated on platinum foils and studied by means of the differential pulse analyzer, alpha decay, decay of the Geiger-Muller activities through various absorbers, and absorption curves. The following activities were reported as resulting from the deuteron bombardment: Pa^{232}, Pa^{230}, Pa^{229}, U^{230}, U^{231}, U^{232}; activities from the helium ion bombardment were Pa^{230}, U^{229}, U^{230}, U^{231}, U^{232}, Np^{234} and a 1.5 day Np. Nuclear property data such as half-lives and characteristic radiations are given for these activities, as well as cross section data for the reactions producing them.

NUCLEAR TRANSFORMATION (continued)

1615 Differential Cross Sections for the Reaction $T^3(p,n)He^3$ from 1 to 2.5 Mev Proton Energies by G A Jarvis, A Hemmendinger, H V Argo and R F Taschek. AECU-157 (LADC-647) nd 1p

This document is in abstract form; it is reproduced below in its entirety.

The angular distributions of neutrons from the $T^3(p,n)He^3$ reaction have been measured in 200 kev steps from the threshold at 1.019 Mev proton energy up to 2.5 Mev. The distributions in the center of mass system were fitted with cosine series and integrated to obtain total cross sections. It is necessary to include cosine cubed terms to fit the data at higher energies. The total cross section rises to 0.55 barns at 2.4 Mev proton energy and is still rising at a fairly rapid rate at this energy.

1616 Neutron-Hydrogen Mass Difference from the $T^3(p,n)He^3$ Reaction Threshold by R F Taschek, G A Jarvis, H A Argo, and A Hemmendinger. AECU-158 (LADC-649) nd 3p

This is not an abstract; the document is reproduced below in its entirety.

The threshold for the reaction $T^3(p,n)He^3$ has been measured by observing the neutrons produced when protons from the Los Alamos electrostatic generator strike a target absorbed in zirconium (E R Graves, A A Rodriquerz, M Goldblatt and D Meyer, Personal communication to be published in Rev Sci Inst). The absolute value of the threshold energy was established relative to the highly accurate $Al(p,\gamma)$ resonance at 993.3 Kev quoted by Herb, Snowden and Sala (Phys Rev 57 246 1949). An assembly carrying the tritium-zirconium plate, a piece of clean 1/32 inch aluminium, a LiF crystal, and a zirconium metal blank allowed rapid interchange of targets in the vacuum. A large liquid air trap was placed immediately in front of the targets, all of which were thick for protons in our energy range.

Gamma rays were counted in double coincidence at right angles to the proton beam and neutrons were counted at 0°. Neutron background below threshold and gamma ray coincidences from protons on the zirconium blank were negligible. The Al target was scraped clean, immediately put into the vacuum, and a beam run on it within about ten minutes; with the beam on the Al and LiF targets ran at near a dull red heat. Over a period of six days, no shift of more than $\pm$ 1 Kev was observed in either the Al resonance stop or the $T(p,n)He^3$ threshold, indicating that no appreciable contaminating layer built up on these targets during the experiment. The tritium-zirconium plate had not been used previously, but had been in air long enough to cause some concern over the possibility of an appreciable oxide coating on the surface. After having obtained a neutron threshold on this target in its original condition, the plate was removed from the vacuum, the surface cleaned with number 600 carborundum and another measurement of the threshold was made as quickly as possible. The two values of the threshold so obtained were within 0.7 Kev of each other, whereas the energy ripple of our machine is approximately 1.5 Kev. Proton currents on the tritium-zirconium targets were kept at about one-fifth of those on the other targets to avoid loss of tritium by heating.

The width of the step in the gamma ray yields were about 2.0 Kev for Al and about 1.0 Kev for F. The thresholds for $T^3(p,n)He^3$ and $Li^7(p,n)Be^7$ were determined to plus $\frac{1}{2}$ Kev and minus 1 Kev. Assuming the $Al(p,\gamma)$ resonance to lie at 993.3 Kev, we then found the $F(p,\gamma)$ resonance at 873.1 Kev and the $Li^7(p,n)Be^7$ threshold at 1880 Kev agreeing with Herb, Snowden and Sala's values to well within our voltage ripple. This scale then puts the $T^3(p,n)He^3$ threshold at 1019 $\pm$ $\frac{1}{2}$ Kev, giving a Q value of -770.0 Kev where the mass factor used was 0.755_6.

Assuming zero neutrino mass and a beta-ray end point of 18.3 Kev, this threshold mass gives the n - H mass difference as 788 $\pm$ 1.5 Kev. The 18.3 Kev end point, which gives the T^3 - He^3 mass difference, has been measured in this laboratory by Graves and Meyer (Personal communication to be published in Phys Rev) and by McKibben and Shurig (Personal communication). This value is in agreement with other recent results [S C Curran, J Angus, A L Cockcroft, Nature 162 302 (1948)]. The neutron proton mass difference determined here is roughly 11 Kev lower than that given by Bell and Elliott [Phys Rev 74 1552L (1948)] and that reported by Jenkins (February 1949 meeting of the American Physical Society in Berkeley California Supplementary Programme). The systematic errors, aside from the absolute energy scale which one would expect in our experiment, are all such as to raise the threshold of $T^3(p,n)He^3$ and therefore the neutron-hydrogen mass difference.

NUCLEAR TRANSFORMATION (continued)

1617 Thresholds for the Photo-Disintegration of Zr^{90}, Pr^{141}, As^{75}, I^{127}, Ni^{58} and La^{138} by William E Ogle. AECU-163 (LA-725) Feb 16 1949 22p

The gamma-neutron thresholds of several elements have been determined using the 20-Mev betatron at Los Alamos by comparing the observed thresholds with the thresholds of N^{14} and F^{19}, where the threshold for $N^{14}(\gamma,n)N^{13}$ reaction was taken as 10.54 and the threshold for $F^{19}(\gamma,n)F^{18}$ reaction was taken as 10.40 Mev. On this assumption the following values were obtained for the thresholds of the reactions quoted: $I^{127}(\gamma,n)I^{126}$ (9.45 ± 0.2 Mev), $Pr^{141}(\gamma,n)Pr^{140}$ (9.8 ± 0.3 Mev), $As^{75}(\gamma,n)As^{74}$ (10.3 ± 0.2), $Zr^{90}(\gamma,n)Zr^{89}$ (12.0 ± 0.2 Mev), $Ni^{58}(\gamma,n)N^{57}$ (11.7 ± 0.2 Mev), and $La^{138}(\gamma,n)La^{137}$ (12.9 ± 0.4 Mev).

1618 Annual Progress Report. October 1 1947 - September 30, 1948. Rice Institute (Office of Naval Research Contract) Oct 1 1948 45p (NP-649)

An Accurate Determination of the Threshold for the Nuclear Reaction $C^{12}(d,n)N^{13}$ by T W Bonner, J E Evans, and J E Hill. The threshold for the production of neutrons from the bombardment of C^{12} by deuterons was found to occur at a bombarding energy of 328 kev. The Q value of the reaction calculated from this threshold is −0.281 ± 0.003 Mev. From this Q value and other disintegration energies the calculated mass difference between the neutron and proton (n - H) is found to be 0.77 Mev.

The Neutrons and Gamma-Rays from the Disintegration of C^{12} by Deuterons by T W Bonner, J E Evans, J C Harris and G C Phillips. The excitation curves for the production of gamma-rays and neutrons resulting from the bombardment of carbon by deuterons have been determined over the deuteron energies 0.7 to 1.9 Mev. A careful study of the very narrow gamma-ray resonance occuring at 1.435 Mev has shown that the half width of the resonance is 5.5 Kev and the cross section is 0.62 barns at resonance. Other gamma-ray resonances were observed at 0.91, 1.16, 1.30, and 1.73 Mev with cross sections respectively of 0.29, 0.34, 0.39, and 0.97 barns. No resonance for the production of neutrons has been observed at, or near, 1.435 Mev. Resonances for the production of neutrons were observed at energies of 0.91, 1.16, 1.30, 1.62, and 1.76 Mev with the total cross section at resonance respectively of 0.12, 0.14, 0.19 and 0.22 barns. The angular distributions of the neutrons has been studied; the distributions are quite complex and vary radically with changes in the bombarding energy. At 1.26 Mev, there are about five times as many neutrons at 160° as at 0° to the direction of the deuteron beam. 18 references.

Neutrons from Deuteron Bombardment of Li^6 by T W Bonner, J E Evans and Ward Whaling. The excitation curve for the neutrons produced by deuteron bombardment of Li^6 has been determined over the deuteron energy range between 250 and 2200 kev. These neutrons are thought to come from the two reactions; $Li^6 + H^2 \rightarrow (Be^8) \rightarrow Be^7 + n + 3.3$ Mev and $Li^6 + H^2 \rightarrow (Be^8) \rightarrow He^4 + He^3 + n + 1.7$ Mev.

Neutrons and Gamma-Radiation from Deuteron Bombardment of Be by J E Evans, C W Malich and J R Risser. Neutron and gamma-ray intensities from thin targets of Be bombarded by deuterons were measured as a function of deuteron energy from 0.2 to 1.8 Mev. Most of the neutron data were obtained in the forward direction with respect to the deuteron beam. Neutron and gamma-ray intensities show exponential increase with energy below 800 kev; a broad resonance in the region 1.0 to 1.1 Mev is indicated by the shape of the curve at energies above 800 Kev. Search revealed no sharp resonances. Evidence is shown for a previously unknown neutron group of Q equal to −0.7 Mev. Neutron intensities were measured as a function of angle with the deuteron beam for a number of bombarding energies from 0.8 to 1.7 Mev. 17 references.

1619 Differential Cross Section for Reaction $D(d,n)He^3$ for 10-Mev Bombarding Energy by K W Erickson, J L Fowler and E J Stovall, Jr Phys Rev 75 894 (1949) Mar 1 (Letter to editor)

This article is based on AECU-89. An abstract of the document has been listed in Nuclear Science Abstracts as Abstract No. II-948.

NUCLEAR TRANSFORMATION (continued)

1620 Particle Groups from the Bombardment of Aluminum by Deuterons by E C Pollard, V L Sailor and L D Wyly Phys Rev 75 725-731 (1949) March 1

Targets of aluminum leaf 30 Kev thick have been bombarded by deuterons and found to emit protons in 14 groups and α-particles in 4 groups. These correspond to levels in Al^{28} and Mg^{25}. The level spacing in Al^{28} appears to become somewhat less at excitation energies of 5 Mev, and the population of the highly excited states is greater. There appear to be 5 major groupings each having a finer structure. Observation at 90° and 0° with respect to the incident deuterons shows a considerable variation in relative yield. In comparison with neutron scattering levels for the same nucleus, the spacing here observed is greater. This may be due to the adverse selection of groups of high angular momentum on account of the Coulomb barrier. The level spacing in Mg^{25} is approximately 0.8 Mev. From the maximum energy of the protons and α-particles the mass difference between Al^{28} and Al^{27} is found to be 1.00073 ± 0.00008, and between Mg^{25} and Al^{27} is 1.99619 ± 0.00006 mass units.

PARTICLE ACCELERATORS

1621 Soft Iron for the Electromagnet of a Cyclotron by J J Went Philips Tech Rev 10 246-254 (1949) Feb

An investigation was made into the properties to be ascribed to a soft iron suitable for the construction of electromagnets as used in cyclotrons. The more important characteristics of ferromagnetic materials are first discussed, such materials being classified in 4 groups. A number of possible applications are then indicated for each group, after which it is shown that the iron from which electromagnets are made must possess high saturation values and relatively high remanence. Taking into consideration the general picture which ferromagnetic materials should present, it is then seen that the last-mentioned requirement can be met only when care is taken to minimize internal strains and any non-magnetic constituents that may be present. Since these desiderata are also conductive to a low coercive force, the same grades of iron can also be employed for the iron cores of relays. Finally, details are given of the conclusions drawn from this review as applied to a practical test in the manufacture of the iron used for a cyclotron built by Philips for the Institute for Nuclear-Physical Research at Amsterdam.

PHYSICS, GENERAL

1622 Multiplicative Systems in Several Variables, III by C Everett and S Ulam. AECD-2532 (LA-707;LADC-588) Oct 28 1948 Decl Mar 21 1949 38p Proposed for publication in Phys Rev (See also AECD-2164 and -2165)

The set Γ_i of all possible genealogies or graphs z of a multiplicative system produced from one particle of type i is here introduced as a fundamental concept in the theory of such systems [3I,II]. This set possesses a natural intrinsic distance function $d(z,z')$ under which it is a complete zero-dimensional metric space satisfying the second axiom of countability. Simple axioms on (A) intervals and (B) measure of intervals are given for an abstract set from which the classical theory of completely additive measure is derived. Intervals in the set Γ_i are defined intrinsically and shown to satisfy the axioms (A). If now a particular multiplicative system with given generating transformation G(x) is given, the transition probabilities $p_1(i;j_1,\ldots,j_t)$ serve to define a measure for the intervals of Γ_i satisying the axioms (B). Proof of the latter is non-trivial, due to non-local-compactness of the space Γ_i. With this mathematical structure at hand, it becomes possible to state in a simple way some of the striking properties of multiplicative systems:

If $x^0 = G(x^0)$ is the death-fix-point of G(x), then the set of graphs of Γ_i which terminate in death has measure x_i^0. If $v = (v_1,\ldots,v_t)$ is the characteristic vector corresponding to the maximal positive characteristic root $r > 1$ of supercritical system, then the set of all graphs of Γ_i whose k-th generation population approaches the ratios $v_1 : v_2 : \ldots : v_t$ has measure $1 - x_i^0$. Thus, almost all graphs (genealogies) either terminate in death or approach the mode v as limit. These results are trivial for subcritical systems, in which by definition, $x_i^0 = 1$.

PHYSICS, GENERAL (continued)

1623 The Vapor Pressure of Tellurium and Selenium by L S Brooks. AECD-2546 (MLM-191) Sept 10 1948 Decl Dec 7 1948 13p Proposed for publication in J Amer Chem Soc

The vapor pressure of tellurium and selenium has been measured with quartz Bourdon gauges, at pressures up to about one-third atmosphere for tellurium, and just over one atmosphere for selenium, with the following results:

	A	B	T_b	L_v
Tellurium	7.5999 ± 0.0136	5960.2 ± 14.5	989.8 ± 3.8	27.26 ± 0.07
Selenium	8.0886 ± 0.0048	4989.5 ± 4.5	684.9 ± 1.0	22.82 ± 0.02

in which A and B are constants in the equation $\log p = A - B/T$, p is the pressure in mm of mercury, T the absolute temperature, T_b the boiling point in degrees centigrade, and L_v the latent heat of vaporization in kilocalories per mole, the probable errors being stated in each case. The results of the present work, which covers the range from about 0.4 to 786 mm of mercury, are in agreement with those of Selincourt [Proc. Phys. Soc. (London) 52, 348-52 (1940)].

1624 Approximate Densities of Liquid He^3 between 1.27 and 2.79 K by E R Grilly. AECU-151 (LAMS-838) Jan 21 1949 8p

A procedure is given for the density determinations using a gas buret-manometer combination and a narrow soft glass capilliary tube. Two methods of calculating the density from the data collected are outlined. The results are portrayed graphically; included for comparison are He^4 density data in the same temperature range.

1625 The Interaction of Nuclear Electric Quadrupole Moments with Molecular Rotation in Asymmetric Top Molecules. II. Approximate Methods for First-Order Coupling by J K Bragg and S Golden Phys Rev 75 735-738 (1949) March 1 (See also Nuclear Science Abstract I-1157)

An expression is developed for the rotational dependence of $(\partial^2 V/\partial z^2)_{Av}$ for asymmetric top molecules. The expression is valid for all rotational energy levels, and requires only a knowledge of the reduced energy spectrum as a function of asymmetry of the rotor. The application of 3 distinct methods of approximating the energy of the asymmetric rotor to the expression for $(\partial^2 V/\partial z^2)_{Av}$ is described. This permits the calculation of quadrupolar interactions for certain rotational states (in particular, those of high J) for which energies have not yet been tabulated. The expressions which are derived will usually prove to be at least as accurate as the first order approximation to the quadrupolar interaction, in which $(\partial^2 V/\partial z^2)_{Av}$ is involved.

1626 An Investigation of the Effect of Fin Spacing on the Performance of Louvered Plate-Fin Heat Exchanger Surfaces by W M Kays. Department of Mechanical Engineering Stanford University Technical Report No. 3 Dec 15 1948. 38p (NP-646)

This report contains the results of basic heat transfer and flow friction tests of three fin-spacing variations of louvered plate-fin type high rating heat exchanger surfaces. All three surfaces have the same plate spacing and louver length. The heat transfer and flow friction characteristics, respectively, are given in both tabular and graphical form using dimensionless correlations. Also included are heat transfer - friction power characteristics evaluated at certain standard gas properties. The test results indicate that the heat transfer characteristics can be well correlated by use of a Reynolds' number based on flow passage hydraulic radius, but that the friction factors correlate on such a basis only at $Re < 1000$. A discussion of the reasons for this behavior is included.

1627 Liberation of Electrons from Metal Surfaces by Ion Bombardment (Liberazione di elettroni da superficie metalliche per urto di ioni) by A M D'Ans, R Da Rios and L Malaspina Nuovo Cimento 5 394-396 (1948) Aug (In Italian)

The liberation of electrons from metal surfaces by ion bombardment plays an important part in several phenomena, being often a disturbing factor, as e.g. in the behavior of the Geiger-Muller

PHYSICS, GENERAL (continued)

counter [Corson and Wilson, Rev Sci Instruments 19 207 (1948)]. Using the experimental set up of Rostagni (Nuovo Cimento 11 34 (1934); Ricerca Sci 9 633 (1938)), the authors studied the phenomenon in a preliminary way. The ions H_2^+, He^+, and A^+ acted upon electrodes of copper, nickel, molybdenum, and lamp-blackened copper. The electrodes had not been submitted to a previous degassing. Curves are shown on which, for every combination of ion and electrode, coefficients of electron liberation k are plotted against $\sqrt{V}$, V being the ion-accelerating potentials. The preliminary character of the work does not allow of any clear interpretation of the data obtained. From a practical standpoint, one should note the very small values of k corresponding to the blackened copper electrode.

1628 Measurements of Ambipolar Diffusion in Helium by Manfred A Biondi and Sanborn C Brown. MIT Research Laboratory of Electronics Technical Report No. 96 Feb 7 1949 13p (NP-693)

Microwave techniques are applied to the study of the diffusion of electrons and positive ions in helium. For the electron and ion densities realized experimentally, the diffusion takes place ambipolarly; that is, the flow of charged particles of both signs is equalized by the space-charge field which they set up. At 1 mm Hg pressure and 0.039 ev average energy, the measured value of the ambipolar-diffusion coefficient, D_a, is 540 cm^2/sec. The measured variation of D_a with gas density, energy of the particles, and diffusion-container size and shape agrees closely with theory.

1629 Possibility of a Phase Transition in the Pure Helium Isotope of Mass 3 by A R Miller Nature 163 283-285 (1949) Feb 19

The possibility of a phase transition in the pure helium isotope of mass three has been investigated. Previous work by Sydoriak, Crilly, and Hammel [Phys Rev 75 3 3 (1949)] provides evidence for such a transition at a temperature of 1.9°K. The vapor-pressures equations in the two ranges, 1.2-1.9°K and 1.9-3.20°K are given, and a few remarks are made concerning the theoretical implications of the existence of a phase transition in He^3. It is concluded from the vapor pressure data that there is a lambda-transition in pure helium-3. It is noted that if helium-3 shows a second-order phase transition, this would provide prima facie evidence that the existence of such a phase transition could not be a consequence of the particular quantal statistics obeyed by the assembly of particles. It would thus rule out any attempt at a theory of the phase transition in helium-4 which depends on the fact that helium-4 atoms obey Bose-Einstein statistics. It is noted that although a phase transition of the second order in helium-3 would indicate that the existence of such transitions is independent of the statistics obeyed by the assembly of particles, the particular properties shown by the assembly below the transition temperature may well depend on these statistics.

1630 Some Properties of Tubular Electron Beams by Nelson Wax J Applied Phys 20 242-247 (1949) Mar

Approximate expressions are obtained for the potential distribution, maximum current density, and beam spread of tubular electron beams of finite thickness. Comparisons are made with previously published results for very thin tubular beams and solid cylindrical beams.

PHYSICS, NUCLEAR - METHODS OF MEASURING

1631 Operations Manual for a Parallel Plate Alpha Counter (Scale of 64) by W L Hood. AECD-2535 (MLM-148) July 15 1948 Decl Oct 18 1948 27p

The parallel-plate alpha counting system described is designed for counting alpha radiation up to 25,000 counts per minute. It is composed of a Model C2T3A scale of 64 scaler, a Model C3T1B or similar parallel plate alpha chamber, a Production Instrument Company EC-84 electromagnetic register or equivalent, and a Precision Scientific Company "Time-It" or equivalent timer. The Model C3T1B parallel-plate alpha chamber includes a parallel plate ionization chamber, a three-stage pulse amplifier and cables for interconnection to the Model C2T3A scaler. A detailed description of this scaler is given. The theory of operation and preparation of the counter for use is described, and

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

schedules are detailed for its maintenance and operation. Detailed drawings, photographs, and wiring diagrams of the counting system are included.

1632 Operations Manual for a Low Count Parallel Plate Alpha Counter (Scale of 8) by W L Hood. AECD-2536 (MLM-147) July 15, 1948 Decl Oct 18 1948 22p

The parallel-plate alpha counting system described is designed for low level counting of alpha radiation. It is composed of a Model C2T2 scale of 8 scaler, a Model C3T1B or similar parallel-plate alpha chamber, a Production Instrument Co. EC-84 electromagnetic register or equivalent, a Precision Scientific Company "Time-it" or equivalent timer, and an Esterline Angus Model AW Graphic Milliammeter 0-1 milliampere or equivalent. The Model C3T1B parallel-plate alpha chamber includes a parallel-plate ionization chamber, a three-stage pulse amplifier, and cables for interconnection to the Model C2T2 scaler. A detailed description is given of the scaler. The theory of operation and preparation of the counter for use, and operation and maintenance procedures are outlined. Specifications, detailed drawings, photographs and wiring diagrams are given.

1633 A Parallel Plate Alpha Chamber with Side Inserted Sample Carrier Assembly by W L Hood. AECD-2542 (MLM-210) Nov 3 1948 Decl Mar 23 1949 29p

The extensive use of parallel plate alpha counters revealed several design features of the instrument which could be changed, thereby improving and simplifying the operations of the counter. The Model C3T1B was therefore developed. It is identical electrically to the interrupted-screw-breach alpha chamber but differs from it mechanically in the following ways: The base of the alpha chamber is not removable for the insertion of alpha samples. They are placed on a sample carrier assembly which slides horizontally into the base of the chamber. This sample carrier assembly consists of a dovetailed metal block upon which is mounted a lucite stand-off insulator, which supports the lower chamber plate. The dovetailed block slides in and out of the chamber on dovetailed ways machined on the top of the chamber base. When the sample carrier assembly is inserted into the chamber, it is locked in position by a cam latch. As the cam is rotated to lock the sample carrier assembly in place, it produces a wedging action which forces the dovetailed surfaces tightly together, thus assuring a good mechanical and electrical contact between the chamber base and the sample carrier assembly. As the sample carrier assembly is slid into position for counting, a banana plug which is located on the forward side of the lucite insulator, engages the high-voltage banana-jack which is located within the chamber.

Detailed drawings are included.

1634 Use of Photographic Plate Detectors in Experiments with the 10-Mev Deuterons by J H Williams, F K Tallmadge and L Rosen. AECU-159 (LADC-643) nd 1p

This document is in abstract form; it is reproduced below in its entirety.

Photographic plates are being successfully utilized to make energy distribution and intensity measurements of the products of reactions induced by the externally focused 10-Mev deuteron beam from the Los Alamos cyclotron. Results of a search for an excited state in the H^3 nucleus will be given. Preliminary results will also be given for D-P scattering. A camera now under construction, which will be capable of simultaneously recording intensity and energy distribution of the charged products of nuclear disintegration and scatterings in 2.5 degree intervals from 10 degrees to 180 degrees with respect to the incident deuteron beam, will be briefly discussed.

1635 Estimation of P^{32} by Measurement of Brehmstrahlen in an Ionization Chamber by Paul C Tompkins and Leon Wish. AECU-162 (ORNL-314) March 17 1949 9p

The absorption of beta particles is always accompanied by the generation of a continuous spectrum of electromagnetic radiation (Brehmstrahlen). The ratio of the energy loss by electromagnetic radiation to loss by ionization increases with the atomic number of the absorber, being some 12 times greater in lead than in paraffin. When the average atomic number of the absorbing medium is

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

is kept reasonably constant, and the activity is large enough, it should be possible to quantitatively determine the activity of a pure beta emitter such as P^{32} by measurement of the Brehmstrahlen generated within the material of the source. The feasibility of this type of measurement has been tested by means of a "100 per cent geometry" ionization chamber filled to a pressure of 600 p.s.i. with helium. The current was amplified with a Model 30 vibrating reed electrometer through resistors of 10^{11}, 10^{10}, 10^{9}, or 10^{8} ohms and the voltage drop measured with a Brown recording potentiometer.

Results demonstrate conclusively that pure beta emitters can be satisfactorily measured through the electromagnetic radiation produced by beta-particle absorption under many conditions encountered in normal chemical work. This procedure has been used to measure several highly active materials encountered in the semihot laboratory, and has eliminated a number of handling steps, thus decreasing both the hazards of laboratory contamination and personnel exposure. It has been adapted to the direct measurement of P^{32} in animal excreta and organs, although the sensitivity is still too low for general use. It is also being used to determine half-lives.

1636 Preliminary Report on Improved Alpha Survey Instruments and Probe by R W Schede. AECU-166 (K-363) Mar 2 1949 10p

An improved alpha survey instrument circuit has been developed with from five to seven times the sensitivity of the standard Zeuto instrument while retaining comparable drift and stability characteristics. Development work is being continued on a probe which can be used with this instrument.

1637 A.E.C. Mark I Model 41A Portable Alpha Detection Equipment by J S Denham. Naval Radiological Defense Laboratory Report ADI-57 Nov 29 1948 14p

The A.E.C. Mark I Model 41A portable alpha rate meter has been examined and tested to determine whether it meets the requirements of field applications. It was found that under specialized conditions of careful handling and use only in areas of relatively low humidity, satisfactory operation can be obtained, but the instrument is considered unsuited for usage in the field. It is affected by moisture and vibration to such an extent that its readings under some conditions are meaningless. The use of a canvas knapsack with a shoulder strap not only makes the instrument subject to physical damage and easy contamination, but also makes it unweildy to handle in restricted spaces.

1638 The Detection of Gamma-Rays with Thallium-Activated Sodium Iodide Crystals by Robert Hofstadter Phys Rev 75 796-810 (1949) March 1

Thallium-activated sodium iodide crystals may be used as efficient detectors of γ-rays and other ionizing radiations. The crystals are used in combination with a photo-multiplier after the manner of Kallmann [Natur and Technik (1947) July]. Curves are given which show the duration of the light emission process, the distribution of light pulse sizes, the energy discrimination possibilities, and the dependence of number of counting events on photo-multiplier voltage and amplifier gain. Comparison curves are shown for NaI(Tl) and anthracene. A description is given of the method of preparation of polycrystalline samples and single crystal specimens of the sodium iodide-thallium phosphor. A few remarks are made concerning the combination of alkali halide phosphor crystals with photographic plates.

1639 The Discharge Mechanism of Self-Quenching G-M Counters by S H Liebson and I H Blifford. Naval Research Laboratory Report NRL-N-3079 May 1947 22p

A split-counter arrangement was used to investigate the absorption coefficient of the radiation which causes the discharge to spread along the wire of a counter after the triggering of a pulse. The counters used were filled with various pressures of methylene bromide and argon, and with ethyl alcohol and argon. The results indicated that the vapor dissipates electron energies, thereby reducing the number of photons produced during the discharge. It was also observed that the absorption coefficient was a function of the argon alone, from which it was concluded that photo-ionization of the argon was responsible for spreading the discharge along the wire. This behavior was also observed with helium and neon in combination with alcohol or methylene bromide.

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

1640 Electronics Catalogue No. 2. National Research Council of Canada Jan 1949 46p (NP-671)

A detailed catalogue of standard AEP (Atomic Energy Project) instruments and AEP assemblies is attached to an electronics newsletter. Included are specifications of some commercial instruments which have proved useful.

1641 Geiger Probe Monitor AEP 1903 Mark 1. National Research Council of Canada nd 7p (NP-687)

The Geiger Probe Monitor Mark 1, has been designed as a transportable mains-operated (power line) instrument capable of measuring low values of beta or gamma radiation with a probe at distances up to 100 feet from the main instrument. It consists of two parts: the Geiger probe, which contains the Geiger tube without any head amplifier, and the counting rate meter with internal high voltage supply for the Geiger. The operation and accuracy of the instrument are discussed.

1642 Illumination of Wilson Chambers by Flash Tubes Filled with Xenon (De l'éclairage des appareils Wilson par tubes à éclairs à xenon) by Marcel Laporte and Jean Teillac J Phys et Radium 9 253-255 (1948) Oct (In French)

Details are given of an illumination device for taking photographs of tracks obtained in a Wilson chamber. The device utilizes discharges of a condenser in a tube filled with xenon. Its performance is efficient, regular, and economical.

1643 Evaluation Report of AN/PDR-3 Direct Reading Quartz Fiber Pocket Ionization Meters by W R Lamb and J J Shapiro. Naval Radiological Defense Laboratory Report ADI-45 Oct 27 1948 8p

Reconditioned AN/PDR-3 direct reading quartz fiber pocket ionization meters were evaluated. The instruments had been used for extensive field service. Conditions found common to all were corrosion of the clips, imperfect machining, extensive internal corrosion, quartz fibers out of focus, dirt and insulation particles of all optical surfaces, nameplate peeling, chipped graphite plug, and varied dimensions of component parts. Certain instruments were restored to normal operating condition. Parts of other instruments were found to be beyond repair or missing. Duplication of field conditions was imposed upon repaired meters. These tests were as follows: leakage and background; radiation calibration; sunlight exposure; heat; vibration; water immersion and shock. These instruments are considered unsatisfactory because of eventful excessive electrical leakage and inability to withstand large temperature changes or high humidity during use.

1644 Evaluation Report of Direct Reading Quartz Fiber Ionization Pocket Meters by W R Lamb and Justin J Shapiro. Naval Radiological Defense Laboratory Report ADI-46 Oct 26 1948 7p

This report is an evaluation of two pocket dosimeters, the Kelley Koett K-100 and the Cambridge Model 7400, and the Kelley Koett K-125 dosimeter charger. Previous history of the instruments included a field test aboard a radioactive vessel during a naval operation. The pocket meters were examined and tested for their ability to measure radiation under conditions most likely to be met in general field service. Their general appearance and type and quality of construction were noted. The leakage and background discharge rates were measured. The accuracy of the instruments was determined by exposing them to calculated gamma-ray intensities. Their ability to retain this accuracy in the field was evaluated by exposing the meters to simulated field conditions in the laboratory. This procedure demonstrated the response of the meters to effects other than gamma-radiation. Fully charged meters were exposed to direct sunlight, totally immersed in water, placed in an oven at desert heat, dropped on a hard surface, and vibrated in a clinical laboratory shaker, and any resulting discharge was noted. The data from these tests are summarized and examined in the report, which concludes with recommendations for the improved design of these pocket ionization meters.

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

1645 Measurements of Behavior and Mobility of Polyatomic Ions by P B Weisz and W P Kern Phys Rev 75 899-890 (1949) Mar 1 (Letter to the editor)

The technique used by H G Stever [Phys Rev 61 38 (1942)] in obtaining a "recovery curve" for Geiger-Mueller tube discharges has been extended to give information concerning the actual progress of the sheath r = r(t) by simultaneously performing 3 experiments: 1. The "recovery curve," i.e., pulse-size of subsequent discharge pulses S as a function of time elapsed since the previous discharge pulse t, at an applied potential V_0. 2. The pulse-size S versus applied potential V for ordinary space-charge free operation. 3. The space-charge density q developed per pulse at $V = V_0$. For a tube in which $r_{max} = b = 1.0$ cm, plots of R r^2 versus t obtained from mixtures of 5.0 cm Hg of argon and 2.5 cm Hg of polyatomic component P; for the 6 normal hydrocarbons C_nH_{2n+2} from ethane (C_2H_8) to heptane (C_7H_{16}), straight lines were obtained between the dead-time radius (at which the measurement becomes possible) to about r = 0.9. A measurement on ethyl alcohol demonstrates that a relationship of mobility with molecular mass is applicable only to a homologous series of molecules.

1646 The Measurement of Beta-Activity by A G Maddock Analyst 73 644-649 (1948) Dec

The author discusses the measurement of β-activity with respect to the following: (1) the attainment of the greatest accuracy in the shortest time, (2) the measurement of the softest or least energetic β-particles and (3) the development of the greatest sensitivity in the determination of specific activity. Some of the earlier methods of measurement are mentioned and it is noted that Geiger-Müller tubes of either the self-quenching or non-self quenching variety, operating scalers or counting rate meters, are about 5 times as sensitive as the previous methods and are therefore the most suitable for working with tracers. Several sources of error and necessary refinements of method and corrections are noted. A nomogram relating the mass absorption coefficient, sample mass and the necessary correction for absorption within the sample is shown. The author estimates that although it is a relatively straightforward process to measure β-activity with about 2% probable error, the attainment of 0.5% probable error or better is a matter of considerable difficulty. 19 references.

1647 The Measurement of Radio-Isotopes by F E Whitmore Analyst 73 650-652 (1948) Dec

A few of the aspects of the measurement and standardization of radioisotopes are discussed. As an example the measurement of a sample of a radio-isotope which decays by the emission of a β-particle followed by one photon is treated in some detail. The use of coincidence arrangements is briefly described. 11 references.

1648 Recent Progress in Alpha-ray Spectroscopy by S Rosenblum Nucleonics 4 No. 3, 38-42 (1949) March

The recent progress in α-ray spectroscopy at the Laboratoire de l'Aimant Permanent of the Centre National de la Recherche Scientifique in Bellevue, France, is discussed. The construction of the 70-ton permanent magnet used to focus α-particles is described and some curves obtained using α-particles from radium, ionium, radiothorium, and thorium-X are shown. It is noted that this apparatus is of particular value in investigating the fine structure of long-lived elements.

1649 A Reciprocal Counting Rate Recorder by S W Lichtman and H Friedman. Naval Research Laboratory Jan 17 1949 5p (NP-624)

The method of "counting interval" recording described combines the desirable features of both the direct counting method and the rate meter strip chart type of recording. In the arrangement described it plots as deflections on a moving strip chart, a sequence of parallel traces such that the envelope of the end points is a curve of the reciprocal of the counting rate versus time. This is accomplished by exciting a recording meter with the voltage derived from a clock driven potentiometer. Alternatively, a direct plot of counting rate versus time, rather than a reciprocal relationship, is obtainable by connecting the recording meter in series with a clock driven rheostat and a constant source of voltage. The control unit for the counting interval recorder was designed for use with a scaling circuit arranged to automatically stop after a predetermined number of events had been counted.

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

In principle, the control unit comprises a clock driven potentiometer, which is operative during the counting interval and a spring reset for restoring the potentiometer to its zero setting, after the specified count has been reached. It also contains a source of stable dc voltage for exciting the potentiometer and thereby the external recording meter. Finally, provision is made for controlling the chart drive excitation of the recording instrument; this being made to provide the option of automatic chart movement either during the counter interval or during the reset period, by manipulation of a toggle switch.

PHYSICS, THEORETICAL

1650 Los Alamos University Lecture Notes Theoretical Mechanics by J Keller, J Ashkin and C Richman. AECU-167 (M-4297) March 1946 137p

A course in theoretical mechanics was given in 1945 at Los Alamos University. The following material was covered: basic concepts (motion of a particle), LaGrange equations, theory of small vibrations, variational principles, Hamiltonian mechanics, action and angle variables, perturbation theory, and rigid bodies.

1651 A New Wave-Mechanical Perturbation Theory (Eine neue wellenmechanische Störrungstheorie) by H Kallmann and M Pasler Ann Physik 3 305-316 (1948) Aug (In German)

A new perturbation calculation method is given for problems which involve second-order differential equations. First the unperturbed differential equation is transformed into a first-order differential equation by means of a La Place transformation. (The method is only applicable in problems where this is possible.) In the La Place transformation of the perturbation function, the form $\Sigma a_n \frac{d^n g(p)}{dp^n}$ is frequently obtained. Thus, the first-order differential equation for g(p) is transformed into one of higher order. The differential expressions of higher order may be expressed directly by successive approximations from g(p). As an application, the Stark effect is considered and it is shown that by simple quadratures, the eigenvalues and eigenfunction may be obtained. The results thus obtained are in agreement with previous results.

1652 On the Possibility of Detecting the Proper Magnetic Moment of Particles of Spin 1/2 (Sur la possibilité de mettre en évidence le moment magnétique propre des particules de spin 1/2) by Louis de Broglie J Phys et Radium 9 265-272 (1948) Nov (In French)

An analysis is made of the theoretical considerations which have led to the recognition of the impossibility of detecting the proper magnetic moment of a particle of spin 1/2 (electron) by using an experimental set up for which the concepts of point mechanics are valid. Bohr's considerations, based on uncertainty relations, are perfectly valid when slow particles are considered; they are, however, inadequate for particles whose velocities approach that of light in vacuum. In making a transition from Dirac's wave equations into point mechanics by the use of the approximation of the geometrical optics, Pauli was led to the conclusion that a point mechanics of spin-possessing particles must be identical with that of particles devoid of spin. The conclusion is thus reached that, in the domain of point mechanics, it is a priori impossible to detect any action of a magnetic-field gradient upon the proper magnetic moment of a particle.

In the present work, the re-examination of the above-mentioned transition to the approximation of geometrical optics leads to different results. In accordance with the ideas recently developed by Jan Weyssenhoff, the point mechanics of a particle having the spin 1/2 is a mechanics of variable proper masses depending on proper magnetic moments. Therefore, there exist no theoretical impossibilities of detecting the magnetic moment by an experiment for which the point mechanics is valid. Practically, it must be difficult to find particles whose masses, charges, and velocities would permit such an experiment. However, difficulties of this kind are purely experimental: they are not based on any theoretical a priori grounds.

PHYSICS, THEORETICAL (continued)

1653 Quantum Electrodynamics. II. Vacuum Polarization and Self-Energy by Julian Schwinger Phys Rev 75 651-679 (1949) Feb 15 (See also Nuclear Science Abstract II-271)

The covariant formulation of quantum electrodynamics, developed in a previous paper [Phys Rev 74 1439 (1948)], is applied to 2 elementary problems--the polarization of the vacuum and the self-energies of the electron and photon. In the first section the vacuum of the noninteracting electromagnetic and matter fields is covariantly defined as that state for which the eigenvalue of an arbitrary time-like component of the energy-momentum four-vector is an absolute minimum. The defining properties of the vacuum state vector established are employed in the calculation of the vacuum expectation values of quadratic field quantities, specifically the energy-momentum tensors of the independent electromagnetic and matter fields, and the current four-vector. The second section treats the induction of a current in the vacuum by an external electromagnetic field. It is demonstrated, in a general manner, that the induced current at a given space-time point involves the external current in the vicinity of that point, and not the electromagnetic potentials. This gauge invariant result shows that a light wave, propagating at remote distances from its source, induces no current in the vacuum and is therefore undisturbed in its passage through space. The absence of a light quantum self-energy effect is thus indicated. The current induced at a point consists, more precisely, of 2 parts: a logarithmically divergent multiple of the external current at that point, which produces an unobservable renormalization of charge, and a more involved finite contribution, which is the physically significant induced current. The latter agrees with the results of previous investigations.

The modification of the matter field properties arising from interaction with the vacuum fluctuations of the electromagnetic field is considered in the third section. The analysis is carried out with 2 alternative formulations, one employing the complete electromagnetic potential together with a supplementary condition, the other using the transverse potential, with the variables of the supplementary condition eliminated. It is noted that no real processes are produced by the first order coupling between the fields. Accordingly, alternative equations of motion for the state vector are constructed, from which the first order interaction term has been eliminated and replaced by the second order coupling which it generates. It is concluded from a comparison of the alternative procedures that, for the treatment of virtual light quantum processes, the separate consideration of longitudinal and transverse fields is an inadvisable complication. The light quantum self-energy term is shown to vanish, while that for a particle has the anticipated form for a change in proper mass, although the latter is logarithmically divergent, in agreement with previous calculations. It is verified, finally, that the energy and momentum modifications produced by self-interaction effects are entirely accounted for by the addition of the electromagnetic proper mass to the mechanical proper mass--an unobservable mass renormalization. An appendix is devoted to the construction of several invariant functions associated with the electromagnetic and matter fields.

1654 Quantum Mechanics as a Statistical Theory by J E Moyal Proc Cambridge Phil Soc 45 99-123 (1949) Jan

An attempt is made to interpret quantum mechanics as a statistical theory, or more exactly as a form of non-deterministic statistical dynamics. The paper falls into three parts. In the first, the distribution functions of the complete set of dynamical variables specifying a mechanical system (phase-space distributions), which are fundamental in any form of statistical dynamics, are expressed in terms of the wave vectors of quantum theory. This is shown to be equivalent to specifying a theory of functions of non-commuting operators, and may hence be considered as an interpretation of quantum kinematics. In the second part, the laws governing the transformation with time of these phase-space distributions are derived from the equations of motion of quantum dynamics and found to be of the required form for a dynamical stochastic process. It is shown that these phase-space transformation equations can be used as an alternative to the Schrödinger equation in the solution of quantum mechanical problems, such as the evolution with time of wave packets, collision problems and the calculation of transition probabilities in perturbed systems; an approximation method is derived for this purpose. The third part, quantum statistics, deals with the phase-space distribution of members of large assemblies, with a view to applications of quantum mechanics to kinetic theories of matter. Finally, the

PHYSICS, THEORETICAL (continued)

limitations of the theory, its uniqueness and the possibilities of experimental verification are discussed. 26 references.

RADIATION SICKNESS

1655 The Clinical Manifestations of Acute Radiation Illness in Goats by Eugene P Cronkite U S Naval Med Bull 49 199-215 (1949) Mar-Apr

The goats considered in this report were exposed to ionizing radiations in amounts ranging from 100 r to more than 10,000 r at Bikini. They were divided into 4 groups based on the severity of their illness and the depression of their leukocyte counts. In group 1, severest radiation illness, the animals survived less than 6 days, mortality was 100%, and sudden death occurred. An extremely marked depression of the leukocyte developed. There was no visible evidence of hemorrhage during life and no epilation. The animals in group 2, severe radiation illness, survived 9 to 15 days and developed a less marked leukopenia. Definite hemorrhagic manifestations with a variable clotting defect occurred, epilation was prominent, and mortality was 100%. In group 3, less severe radiation illness, survival was in excess of 44 days and 2 were alive 1 1/2 years later. The signs were similar to group 2 but developed with less rapidity and severity. A moderate leukopenia was present, and epilation was minimal. Hemorrhagic phenomena were less prominent and a clotting defect was not found. In group 4, mild radiation illness, survival was in excess of 184 days. Six of 9 were alive 1 1/2 years after irradiation. Signs were mild and of short duration. Hemorrhage, epilation, and rhinitis were absent. The clinical picture in goats is similar to that of man except for the absence of vomiting and the more rapid progression of signs. Penicillin and whole blood transfusions were used therapeutically. For lack of comparatively exposed control animals definite conclusions cannot be drawn about the usefulness of these agents. The data suggest that they may be of value.

1656 The Failure of Folic Acid to Alter the Clinical Course and Hematologic Picture of Fatal Single Total Body Irradiation in Swing by E P Cronkite, J L Tullis, C Tessmer and T W Ullrich. Naval Medical Research Institute Report No. 18 Sept 30 1948 7p (NP-603)

Eight swine were exposed to 400 r total body radiation. Four were treated with intramuscular injections of 45 mg of folic acid per day. The clinical and hematological courses were observed and postmortem examinations were performed. No differences were observed in the responses of the treated and untreated swine. Folic acid in the dose used was found to be of no value in the therapy of swine exposed to 400 r total body irradiation.

RADIOACTIVITY

1657 Papers for Plutonium Project Record, Volume 9B, Chapter 7, ed by N Sugarman. AECD-2499 nd Decl Mar 21 1947 50p For publication in NNES

The individual papers comprising this document are abstracted below.

1658 Search for Cs^{135} from I^{135} by B Finkle and N Sugarman. AECD-2499-A. nd 3p

Periodic extractions of Cs from an I stock solution led to a minimum value of 1200 years for the half-life of Cs^{135}, on the assumption that the β-radiations would be observed in the normal counting apparatus.

1659 Study of the 13d Cs Found in Fission by B Finkle, D W Engelkemeir and N Sugarman. AECD-2499-B nd 11p

A Cs isotope of 13 ± 1 day half-life has been found in uranium and plutonium fission. The radiations of this isotope are β, 0.28 Mev; γ, 1.2 Mev. The β- and γ-radiations are coincident. The fission yield of the 13 day Cs is found to be 8×10^{-3} per cent. From the low value of the fission yield, it is likely that the 13 day Cs is isomeric with another fission Cs isotope. The mass assignment of the 13 day Cs is limited to masses 135, 137, or 138.

1660 The Fission Yield of 85m Ba^{139} by S Katcoff, B Finkle and N Sugarman. AECD-2499-C nd 4p

The U^{235} fission yield of 85 min. Ba^{139} has been determined in samples of UNH (uranyl nitrate hexahydrate) bombarded in the Argonne pile. The average value obtained, based on a fission yield of 6.1 per cent for Ba^{140}, was 6.3 per cent. 13 references.

1661 The Characteristics of 12.8d Ba^{140} by R R Edwards. AECD-2499-D nd 4p

This is a review of the literature concerning the characteristics of the above isotope. The half-life is given as 12.8 ± 0.05 days by Glendenin (private communication) and 12.83 by Engelkemier and Freedman (unpublished work). Aluminum absorption curves indicate a maximum beta energy of 0.8-1.2 Mev.

1662 Gamma Radiations from Ba^{140} by D W Engelkemier. AECD-2499-E nd 9p

A γ-ray of $\sim$0.5 Mev has been found associated with the 12.5 day Ba^{140}. It is coincident with a β-ray of $\sim$0.4 Mev occurring in 25 per cent of the disintegrations.

1663 The Characteristics of 40h La^{140} by R R Edwards. AECD-2499-F nd 6p

The half-life of La^{140} is reported as 40.0 ± 0.5 hours shown by two decay curves exponential over 8 and 13 half-lives. The maximum β-energy as determined by Al absorption appears to be 1.8 Mev; this value probably arises from the inability to distinguish the 1.45 and 2.2 Mev particles found spectrometrically. Lead absorption curves consistently have shown a weak γ at 0.3-0.5 Mev and another at about 2.0 Mev.

1664 Experimental Study of the Growth of La^{140} from Ba^{140} by B Finkle and N Sugarman. AECD-2499-G nd 4p

The β-activities of two Ba samples containing only the 12.8 day Ba^{140} activity were followed for many weeks. The activity increased initially because of the growth of the La daughter activity; then after coming into transient equilibrium it decayed with a 12.8 day half-life. The ratio of the extrapolated value of the equilibrium decay curve to zero time to the initial Ba activity is 2.44 and 2.54 in the two samples. In order to see whether the high ratio obtained could be explained by the difference in absorption and scattering of the Ba and La β-radiations, the activities were corrected to zero absorber using Al absorption curves. Results of the calculations are given in tabular form. The calculated ratio agrees with the theoretical ratio after correcting for absorption and scattering along the Al absorption curve. This result shows that there can be little possibility that conversion electrons are present in either the Ba or La activities in high counting yield.

RADIOACTIVITY (continued)

1665 Independent Fission Yield of La^{140} by N Sugarman. AECD-2499-H nd 6p

The purpose of this experiment was to determine the fraction of the La^{140} activity formed independently in fission, i.e., that fraction of the yield of chain 140 which arises from the direct formation of La^{140} in fission. A maximum fission yield of ~0.2 per cent was set on the independent formation of 40 hour La in fission.

1666 The Discovery of 19m La^{143} by H Gest and R R Edwards. AECD-2499-I nd 3p

Studies of the rate of 33-hour Ce^{143} growth in samples of active La isolated from U fission products has indicated a half-life of about 19 min.for La^{143}.

1667 Decay of 8 Day Iodine^{131} to a Metastable State of Xenon^{131} by A R Brosi, T W DeWitt and H Zeldes. AECD-2547 Feb 18 1949 Decl Mar 23 1949 Proposed for publication in Phys Rev

A radioactive gas with a half-life of approximately 11 days has been found associated with the 8-day I^{131} produced at Oak Ridge National Laboratory. It is shown to be an excited state of Xe^{131} decaying with an approximately 165 Kev gamma ray as well as softer x-radiation. Comparison with other similar findings is indicated.

1668 Papers for Plutonium Project Record, Volume 9B, Chapter 7, ed. by N Sugarman. AECD-2548 nd Decl Mar 22 1949 96p For publication in NNES

The individual papers of this document are abstracted below.

1669 The β- and γ-Radiations from the Chain 77h Te → 2.4h I by T B Novey, W H Sullivan, C D Coryell, A S Newton, N R Sleight and O Johnson. AECD-2548-A (CC-763) nd 24p

Absorption measurements have been carried out on the β- and γ-radiations of 77h Te with varying amounts of 2.4h I daughter, and 2.4h I. The 2.4h I emits two β- rays in roughly equal intensity: 0.9 and 2.2 Mev, and emits two γ-rays, 0.6 and 1.4 Mev. The 77h Te emits soft β-rays of ~0.1 Mev and 0.28 Mev, together with about 0.7 e^- (70% photoelectrons) per disintegration of ~0.1 Mev in energy and a γ-ray of 0.22 Mev. Possible nuclear decay schemes are proposed.

1670 Characteristics of Some Iodine Isotopes Produced in Fission by W H Sullivan, O Johnson and R Nottorf. AECD-2548-B nd 11p

The β- and γ-ray energies of 6.7h I^{135} and 22h I^{133} fission isotopes were determined by differential absorption-decay curve measurements. The applicability of this technique was checked by the simultaneous determination of the β- and γ-ray energies of the 9.2h Xe^{135} and 8.0d I^{131} isotopes. The 6.7h I^{135} was found to have β- and γ-ray energies of $1.5_5 \pm 0.1$ Mev and 1.3 Mev, respectively; and the 22h I^{133}, β- and γ-ray energies of $1.3_5 \pm 0.1$ Mev and 0.55 Mev, respectively. The 9.2h Xe^{135} was found to have a 1 ± 0.05-Mev β and a 0.26-Mev γ. The 0.36-Mev γ of 8d I^{131} was checked also.

1671 Characteristics of the 6.7h I^{135} by L E Glendenin and R P Metcalf. AECD-2548-C nd 18p

A reinvestigation of the fission yield and decay characteristics of the chain of mass 135 has been made. From the reinvestigation of the chain, certain physical constants have been revised and new facts concerning the chain have been ascertained. A maximum life of I^{135} has been more accurately determined as 6.7 ± 0.1h. Previous values for the fission yield of I^{135} have been found to be in error because of incomplete interchange of the radioactive I^{135} with carrier I, and a new procedure for the separation of radioiodine has been developed which assures complete interchange and therefore complete radioiodine separation. On the basis of the new radioiodine separation method, the fission yield of I^{135} has been determined as 5.6 ± 0.3 per cent. The half-life of the ground state of Xe^{135} has been revised to 9.2 ± 0.1h. The observations of others that the ~33y fission Cs is not of mass 135, and that Cs^{135} must be very long-lived have also been confirmed. From the above work, the present picture of the

RADIOACTIVITY (continued)

chain 135 is as follows: 1m Te $\rightarrow$ 6.7h I $\xrightarrow{10\%}$ 12m Xe* $\xrightarrow{\text{I.T.}}$ 9.2h Xe $\xrightarrow{90\%}$ v. long-lived Cs $\rightarrow$ stable Ba. 16 references.

1672 Characteristics of the 9.2h Xe^{135} by A S Newton, W H Sullivan, O Johnson and R Nottorf. AECD-2548-D nd 5p

Opportunity was afforded to check the decay constants of the 9.2h Xe^{135}. Also during experiments with fission product iodine samples, it was possible to check the β- and γ-ray energy values for the 9.2h activity. Decay measurements on Xe^{135} in the active rare gases separated from neutron-bombarded U gave half-life values which averaged 9.2 $\pm$ 1h. From Al and Pb absorption measurements, the β-ray energy of Xe^{135} was found to be 0.95-1.05 Mev, and the γ-ray energy, 0.26 Mev.

1673 Spectrometer Measurements of the 40h La^{140} Radiations by R Wilkinson, Waldo Rall, L C Miller and L F Curtiss. AECD-2548-E nd 5p

The β- and γ-ray spectra of 40h La^{140} have been studied on a magnetic lens spectrometer. The β-ray spectrum appears to consist of two groups, the main one with an end point of about 1.45 $\pm$ 0.10 Mev and a weaker one with an end point of about 2.2 $\pm$ 0.1 Mev. Gamma rays of the following energies were found: 0.335, 0.49, 0.83, 1.63 and 2.3 Mev.

1674 The Identification and Characterization of 11d Nd^{147} by J A Marinsky and L E Glendenin. AECD-2548-F nd 19p For publication in NNES

A detailed study has been made of the 11d Nd activity which occurs in fission. The separation and identification of this activity as an isotope of Nd was achieved by the amberlite-resin adsorption-elution method. The half-life of this radioisotope is 11.0 $\pm$ 0.3d, and its decay is characterized by a 0.9 Mev β, a $\sim$0.4 Mev γ, an x-ray of $\sim$40 Kev, and conversion electrons. A decay mechanism is proposed. The fission yield of the 11d Nd activity is 2.6 per cent. Its mass has been shown to be 147 by spectrography. 19 references.

1675 A Study of Nd and Element 61 Activities Induced by Neutron Irradiation of Nd by J A Marinsky and L E Glendenin. AECD-2548-G. nd 14p

A study has been made of the element 61 and Nd activities produced by irradiation of Nd with pile neutrons. Five active isotopes, 11d Nd^{147}, $\sim$3.7y element 61^{147}, 47h 61^{149}, a 1.7h activity, and a 12m activity are observed. The 1.7h activity is identified as an isotope of Nd by the amberlite-resin adsorption-citrate elution method. Its decay is characterized by a 1.5-Mev β-radiation and this activity is a assumed to be the parent of 47h element 61^{149}. The 12m activity has not been identified, but is tentatively assigned to element 61 with a probable mass of 151. The cross sections for the production of these five isotopes by pile neutrons are also calculated.

1676 Papers for Plutonium Project Record, Volume 9B, Chapter 7, ed. by N Sugarman. AECD-2550 nd Decl Mar 21 1949 41p For publication in NNES

The individual papers of this document are abstracted below.

1677 Identification and Yield of 34h Br^{82} in Fission by M H Feldman and L E Glendenin. AECD-2550-A nd 8p

The first shielded isotope, 34h Br^{82}, has been isolated in fission. Its fission yield is about 3×10^{-5} per cent. This is a direct measurement of the yield of a primary fission product and gives direct information as to the distribution of nuclear charge among primary fission fragments of given mass numbers.

RADIOACTIVITY (continued)

1678 Identification and Yield of the 19.5d Rb^{86} in Fission by M H Feldman and L E Glendenin. AECD-2550-B nd 7p

A second shielded isotope, 19.5d Rb^{86}, has been isolated in fission. Its fission yield is about 1.6×10^{-4} per cent. Rubidium and cesium were first separated from uranyl nitrate solution by precipitation with $HClO_4$ plus absolute alcohol. Initial attempts to separate Rb from Cs were made by repeated rapid precipitations of Cs as silicotungstate. If the precipitations were done by allowing the precipitate to age 24 hours, the efficiency of Cs removal was higher, being greater than 99 per cent. The required decontamination factor of 10^6 was accomplished in three precipitations. A detailed procedure for the separation of Rb from $UO_2(NO_3)_2$ solutions is included.

1679 Long-Lived Ru-Rh Chains in Fissions by L E Glendenin and E P Steinberg. AECD-2550-C nd 13p

An investigation of the long-lived Ru activities in fission is described. The half-lives of these Ru isotopes have been determined as 40d and 330d respectively. Two Rh activities with half-lives of 30s and 57m have been discovered in the course of this study. The 30s Rh activity is shown to be the daughter of the 330d Ru activity, and its decay is characterized by a $\sim$4-Mev β-radiation. A 4-5 Mev β appears to accompany the decay of the 57m Rh activity. The 40d Ru decays with a 0.2 Mev β-, a 0.56 Mev γ-radiation, and probably soft electrons. The β-radiation of the 330d Ru activity is so soft that it is not easily observed.

1680 Search for the β-Radiation of the 1.0y Ru^{106} Activity by N R Sleight, T B Novey and L E Glendenin. AECD-2550-D nd 3p

All efforts to find the β-radiations from 1y Ru^{106} succeeded only in showing that its energy must be less than $\sim$5 Kev.

1681 Absence of Long-Lived Pd Isotopes in Fission, III by D C Lincoln. AECD-2550-E nd 3p

An attempt to isolate a long-lived Pd activity has succeeded only in demonstrating that if Pd^{107} is long-lived and if its radiation is measurable, its half-life must be exceedingly long (of the order of 10^8y).

1682 A Note on the Discovery of 44d Cd^{115} in Pu Fission by L E Glendenin. AECD-2550-F nd 3p

This is not an abstract; the note is reproduced below in its entirety.

Two Cd samples were isolated according to the standard procedure [L E Glendenin Report CN-1312 May 15 1945; PPR Vol 9B 8.14.2 (1946)] from Pu which had been irradiated. Decay curves were taken with the samples on the first shelf of a standard counter and showed half-lives of 43d and 45d over a period of 7-8 half-lives. The best value of the half-life is therefore 44 $\pm$ 1d.

Two Al absorption curves, taken with the samples on the first shelf of a standard counter, indicated the presence of a single β-component. Feather analysis gave ranges of 760 mg/cm^2 and 800 mg/cm^2, which correspond to energies of 1.72 Mev and 1.68 Mev. The best value for the energy of the β-component is taken as 1.70 $\pm$ 0.02 Mev.

L. Seren and co-workers [CP-1903 July 6 1944; PPR Vol 9B 7.24.1 (1946)] have assigned a mass of 115 to the 44d Cd activity. This activity has been discovered independently by Metcalf [CC-2310 January 1 1945; CN-1911 July 12 1944; PPR Vol 9B 7.24.2 (1946)] in the fission of U.

1683 Discovery of Long-Lived Sb in Fission by G W Campbell, N R Sleight and W H Sullivan AECD-2550-G nd 4p

A weak long-lived Sb activity, having an apparent half-life of 250-300d was found. Fractionation experiments failed to disprove the identity of this activity with Sb. The β-ray energy was found to be $\sim$ 0.6 Mev from absorption measurements in Al.

RADIOACTIVITY (continued)

1684 Papers for Plutonium Project Record, Volume 9B, Chapter 12 ed. by N Sugarman. AECD-2551 nd Decl Mar 23 1949 12p For publication in NNES

The individual papers of this document are abstracted below.

1685 Observations Concerning the 210d Rh^{102} Activity by W H Sullivan, N R Sleight and E M Gladrow. AECD-2551-A nd 5p

The 210d Rh^{102} activity discovered in fast neutron-bombarded Ru by Minakawa [Phys Rev 60 (1941)] was found to be produced by a (d,n) reaction in Ru. The γ-rays mentioned by Minakawa were found to have a half-value thickness of 4.1 gm/cm^2 Pb ($\sim$0.46 Mev) and are possibly due to the annihilation radiation of the positrons found by Minakawa. The observation of the presence of a strong x-ray, characteristic of that for Ru, suggests that the isotope may decay by K-electron capture also.

1686 Search for the Daughter Element-43 Activity of the 2.8d Ru^{97} by W H Sullivan, N R Sleight and E M Gladrow. AECD-2551-B nd 4p

In the search for the daughter activity of 2.8d Ru^{97}, a very soft electron radiation was observed in the element-43 fraction separated from but contaminated by Ru^{103}. It was considered likely that this radiation was due to the 90d element-43 activity, which was the only long-lived 43 isotope known to emit soft electrons (0.097 Mev).

1687 Search for the Previously Reported 20m Ru^{95} Activity by W H Sullivan, N R Sleight and E M Gladrow. AECD-2551-C nd 3p

The 20-24m Ru activity reported by Pool et al [Phys Rev 52 239 (1937)] and DeVries and Veldkamp [Physica 5 249 (1938)] was not found in specially purified Ru bombarded with fast neutrons.

1688 Bound Electron Creation in the Decay of Tritium by P M Sherk Phys Rev 75 789-791 (1949) Mar 1

The relative probabilities of K creation and β-emission are calculated for both molecular and atomic tritium. This ratio is shown to be 0.0035 for the molecule and 0.0065 for the atom, assuming the maximum kinetic energy of the β-rays to be 16.9 Kev.

1689 The Conversion of Gamma Rays of In^{111} (Die Konversion der Gammastrahlen des In^{111}) by F Boehm, O Huber, P Marmier, P Preiswerk and R Steffen Helv Phys Acta 22 69-77 (1949) (In German)

The coefficients of K- and L-internal conversion of In^{111} γ-rays are investigated by means of coincidence measurements. The following results have been obtained:

E_γ = 173 Kev: $(N_e/N_\gamma)_K = (8.1 \pm 0.8) \cdot 10^{-2}$; $(N_e/N_\gamma)_L = (0.9 \pm 0.1) \cdot 10^{-2}$

E_γ = 247 Kev: $(N_e/N_\gamma)_K = (3.6 \pm 0.5) \cdot 10^{-2}$; $(N_e/N_\gamma)_L = (0.6 \pm 0.1) \cdot 10^{-2}$

From comparison with the theories of internal conversion the multipole orders of these γ-rays are determined. Electric quadrupole and magnetic dipole radiations are found to occur in the 173 Kev transition while electric quadrupole radiation is present in the 247 Kev γ-ray. Both transitions are not accompanied by parity changes.

1690 Electron-Neutrino Angular Correlation in the Beta-Decay of He^6 by James S Allen, H R Paneth and A H Morrish Phys Rev 75 570-577 (1949) Feb 15

The recoil nuclei emitted during the β-decay of He^6 have been detected by means of an electron multiplier tube, and the β-rays counted by means of an end window Geiger counter. The energy spectrum of the recoils has been studied by recording coincidences between the 2 detectors as a function of the retarding potential between a set of grids in the path of the recoils. Beta-recoil ion coincidences have been observed when the directions of emission of the β-particle and of the recoil ion was 180° and also 162°. In both cases the best agreement was obtained when the recoil spectra were compared with the curves predicted by the $1 - (v/3c)\cos\theta$ electron-neutrino angular correlation.

RADIOACTIVITY (continued)

1691 Hf^{175}, a New Radioactive Isotope of Hafnium by Geoffrey Wilkinson and Harry G Hicks Phys Rev 75 696-698 (1949) Feb 15 (Letter to the editor)

This article is based on AECU-80. An abstract of the document has been listed in Nuclear Science Abstracts as abstract No. II-992.

1692 Measurement of the Half-Life and Average Energy of Tritium Decay by G H Jenks, J H Ghormley and F H Sweeton Phys Rev 75 701-702 (1949) Feb 15 (Letter to the editor)

Recently, Novick [Phys Rev 72 972 (1947)] and Goldblatt et al [Phys Rev 72 973 (1947)] have found the half-life period of tritium to be considerably less than the 30-year period previously accepted. The authors have determined the half-life of tritium as 12.46 ± 0.2 years, in agreement with the 12.1 ± 0.5 years reported by Novick. In addition the average energy of the tritium decay was found to be 5.69 ± 0.06 Kev. The calorometric method used is described.

1693 Precision Wave-Length and Energy Measurement of Gamma Rays from Au^{198} with a Focusing Quartz Crystal Spectrometer by Jesse W M DuMond. California Institute of Technology Special Technical Report No. 3 Mar 30 1948 7p (NP-640) (See also Nuclear Science Abstract I-1924)

The two-meter-focal-length focussing curved quartz crystal spectrometer described previously has been put into operation with nuclear gamma rays. The 0.41 mev gamma ray line from a 1 curie sample of the radioactive isotope of gold (Au^{198}) of half life 2.7 days has been studied and five independent precision measurements of this wave-length have been made with a precision estimated at about one part in four thousand. It is indicated that the x-ray and gamma ray regions of the spectrum have been joined with comparable precision on both sides thereby opening up a new field in precision nuclear physics as well as many new possibilities in the unravelling of complicated schemes of disintegration.

1694 The Radiations from 2.7-Day Au^{198} by Paul W Levy and E Greuling Phys Rev 75 819-826 (1949) March 1

The radiations from the 2.7-day Au^{198} activity were investigated with a counter and photographically recording β-ray spectrometer. The shape of the continuous β-ray spectrum is essentially that of an allowed spectrum with some additional intensity in the region below 0.6 Mev. The maximum energy of the spectrum is 0.966 ± 0.010 Mev. Very strong conversion lines are observed from a γ-ray of 0.408 ± 0.004 Mev, and weak conversion lines attributed to γ-rays of 0.157 ± 0.002 and 0.208 ± 0.002 Mev were detected. These weak lines and the deviation of the spectrum from the theoretically permissible spectra suggest that the β-ray spectrum may be complex with a component of 0.601 ± 0.016 Mev maximum energy occurring in 15%, or less, of the disintegrations. This suggested mode of decay is consistent with the theoretical analysis of the spectrum and half-life. In terms of this theory the 0.966-Mev transition is described by the polar-vector or pseudo-scalar interaction corresponding to a nuclear spin change of ±1, with no parity change.

RADIOGRAPHY

1695 The Fundamental Action of Intensifying Screens in Gamma Radiography by E L Harrington, H E Johns, A P Wiles and C Garrett Can J Research 26 F 540-551 (1948) Dec

The nature of the intensifying action of lead screens and Patterson screens has been investigated for γ-radiography. For the lead screens used it was found that nearly 52% of the blackening of the film is due to electrons ejected from the front screen and nearly 48% due to electrons ejected from the back screen. The blackening of the film due to the absorption by the film itself of the radiation is small. Similar results were obtained with Patterson screens except that about 10% of the effect of the screens is due to low energy radiation (light) which was stopped by 3 mgm. per cm^2 of aluminum.

RADIOTHERAPY

1696 Beta Irradiation of the Eye by William F Hughes, Jr. and Charles E Iliff Amer J Ophthmol 32 351-360 (1949) March

Beta particles of radon represent a concentrated source of irradiation which is largely absorbed within the first 2 mm of tissue and is therefore useful in the treatment of superficial conditions of the lid, the conjunctiva, cornea, and sclera. The effective use of β-irradiation in ophthalmology depends upon an exact knowledge of the differential between the sensitivity of normal tissues and the pathologic tissues to be destroyed.

In general, lymphoid tissues (the follicles in vernal conjunctivitis), epithelial growths (papillomas), and vascular endothelium (in corneal vascularization) form the most sensitive tissues which can be destroyed by β-irradiation without undue injury to the normal ocular structures. Because of the great sensitivity of the corneal epithelium and stoma cells, direct irradiation over the cornea should be used with caution. Corneal vascularization is best obliterated by irradiation over the scleral portion of the limbus. An ocular condition associated with great cellular destruction or pyogenic infection may respond poorly to β-irradiation.

1697 Clinical Radiation Dosage by Lionel Cohen Brit J Radiology 22 160-163 (1949) Mar

A clinical unit of radiation dosage (the rec or roentgen equivalent clinical) based on the roentgen under standard treatment conditions, is described. The relative biological effects of specific ion-density, over-all time, and field size are calculated so that equivalent dosage can be obtained under all treatment conditions. Absolute lethal tumor doses and tissue tolerances can be expressed in this unit and remain valid under all treatment conditions. One Kilorec is equivalent to 1 standard erythema dose under all treatment conditions.

1698 Further Studies on the Radiosensitivity of Tumors Autogenous to Homozygous Hosts by Anna Goldfeder Radiology 52 230-238 (1949) Feb

The growth characteristics in tissue culture of 2 analogous mammary mouse tumors, both diagnosed as adenocarcinoma, irradiated and non-irradiated are described. Both tumors originated in inbred strains of mice, C3H and dba. A great difference was found between the radiosensitivities of these analogous tumors. Thus, the slower growing tumor of the C3H strain proved to be more radioresistant when grown in vitro than the faster growing one of the dba strain. This is contrary to previous observations in vivo, which showed the tumor of the dba strain to be the more radioresistant. Some explanation for the mechanisms governing growth in vitro and in vivo are offered.

The mammary tumor of the dba strain exhibited a greater glycolytic activity than the mammary tumor of the C3H strain. This corresponds to the fact that faster growing tissues possess a greater glycolytic activity, as the dba is the faster growing tumor of the two. It is concluded that intrinsic qualities unobscured by the host can be revealed in in vitro studies. The correlation of results obtained from in vivo and in vitro experiments may lead to a better understanding of radiosensitivity tumors, and consequently to a better evaluation of therapeutic dosage.

1699 A Note on Tangential Irradiation Without the Use of Bolus Packing by J R Clarkson Brit J Radiology 22 173-176 (1949) Mar

Measurements have been made on the dosage during irradiation of flat and curved surfaces by X-ray beams inclined at grazing incidence, or at a small angle to the surface. It is shown that when the surface is not covered by bolus packing, there are several advantages over the usual method of irradiation. The dosage across the surface is often more uniform, especially in a direction perpendicular to the beam; the errors due to incomplete packing are avoided, and the surface dose may often be calculated to a satisfactory degree of accuracy by the inverse-square law alone. The dosage decreases very rapidly with increasing depth below the surface, which is an important feature when harm to underlying bodily organs is to be avoided.

RADIOTHERAPY (continued)

1700 Roentgentherapy of Pain by Origène Dufresne Can Med Assoc J 60 227-229 (1949) March

After reviewing the nature of pain and the nerve paths carrying it, the author presents two general modes of action by which X-rays may control pain. The first, of which irradiation of the paravertebral ganglia is an example, is by inhibition or paralysis of the nerve fibers themselves; it is used particularly for pain conducted by nerves of the sympathetic system. The second method of radiotherapy depends upon an indirect action on the nervous elements through humoral modification. According to Gilbert's theory, the damaged cells liberate adenosine tri-phosphate, a strong vasodilator. X-rays also relieve pain by destroying inflamed or tumorous tissues which press on nerves, as in the treatment of Hodgkins disease. Whatever their mode of action, X-rays give relief in cases of neuralgia, and all sorts of refractory pains. The article ends with an outline of the general technique for the treatment of pains.

RARE EARTHS AND RARE EARTH COMPOUNDS

1701 Papers for Plutonium Project Record Volume 9B, Chapter 8, ed by N Sugarman. AECD-2530 nd Decl Mar 18 1949 44p For publication in NNES.

The individual papers comprising this document are abstracted below.

1702 A Rapid Separation of the La and Y Groups of the Rare Earths by N E Ballou. AECD-2530-A nd 5p

A rapid separation of the La group from the Y group has been developed. The separation is accomplished by boiling a 6 per cent K_2CO_3 solution of these elements until a crystalline precipitate is formed. This precipitate of $K_5La_3(CO_3)_7$ removes about 97 per cent of the La, carries about 80 per cent of carrier-free Pr from the solution and leaves 90-95 per cent of the Y in solution as a complex carbonate. The precipitate of $K_5Pr_3(CO_3)_7$ removes about 95 per cent of the Pr and carries about the same fraction of carrier-free La from the solution.

1703 Behavior of Nd, Sm, Eu and Element 61 in La-Y Separations with K_2CO_3 by J A Marinsky. AECD-2530-B nd 3p

The behavior of Nd, element 61, Sm and Eu activities in La-Y separations by the modified method of Noyes and Bray (Qualitative Analysis for the Rare Earths, New York, Macmillan, 1927) has been studied. Neodymium and element 61 are carried in the La fraction whereas Sm and Eu fractionate with Y. These activities, however, are not carried quantitatively by La or Y carrier.

1704 A La-Pr and Nd Separation by Fusion with $NaNO_3$ by N E Ballou and J A Marinsky. AECD-2530-C nd 5p

The procedure of Noyes and Bray (Qualitative Analysis for the Rare Elements, New York, Macmillan, 1927) for the separation of La from Pr and Nd has been modified for application to radiochemical problems. The modified method, based on the oxidation of Pr by fusion with $NaNO_3$, has been shortened considerably, and it separates La from Pr and Nd to an appreciable extent.

1705 A Pr-Nd Separation by Alkaline Fusion by N E Ballou. AECD-2530-D nd 4p

A separation of Pr from Nd, satisfactory for many radiochemical purposes, has been developed. It is based on the oxidation of Pr by fusion in KOH for 15 minutes at 400°C.

1706 Procedure for the Isolation of Sm Fission Activity by L Winsberg. AECD-2530-E nd 5p

Samarium is separated from all fission products other than the rare earths by means of fluoride and hydroxide precipitations. Samarium and europium are then separated from the other rare earths by extraction with Na amalgam and removal from the amalgam with 2 N HCl. Europium is then reduced with Zn amalgam and $Sm(OH)_3$ is precipitated, leaving Eu^{++} in solution.

RARE EARTHS AND RARE EARTH COMPOUNDS (continued)

1707 Procedure for the Isolation of Eu Fission Activity by L Winsberg. AECD-2530-F nd 4p

Europium (along with the other rare earths) is separated from the remaining fission products by precipitating the insoluble EuF_3. The fluoride is dissolved with boric and hydrochloric acids. Barium and strontium hold-back carriers are added and the $Eu(OH)_3$ is precipitated to remove the Ba and Sr activities and to free the Eu of oxidizing agents. The Ba-Sr separation is repeated. The $Eu(OH)_3$ is dissolved in HCl; Ce carrier and amalgamated Zn are added, and the mixture is heated to reduce the Eu^{+++} to the divalent ion. On adding NH_4OH, the $Ce(OH)_3$ precipitates, carrying down all the other rare earths but the soluble Eu^{++}, which remains in solution. The separation is repeated; the europous ion is oxidized by ozone, and the oxalate is precipitated and ignited.

1708 Rapid Determination of Rare-Earth γ Activities by D N Hume and R I Martens. AECD-2530-G nd 6p

A rapid procedure is presented for the estimation of rare-earth γ-activity in fission material. The method makes use of the efficient decontamination from Zr and Cb (the other principal γ-emitters in older fission material) provided by rare-earth fluoride precipitations. The rare earth γ-emitting activities separated are La, Ce, Nd, and Eu.

1709 Preparation of Carrier-Free Trivalent Rare-Earth Tracer by N E Ballou. AECD-2530-H nd 4p

A procedure for the preparation of carrier-free rare-earth tracer activity containing a mixture of Y, La, Pr, Nd and element 61 activities from fission is presented. The method makes use of the coseparation of these rare-earth activities from fission material on CeF_3 precipitated with an HF-KF mixture. The rare-earth activities are then removed from Ce by subsequent precipitation of $Ce(IO_3)_4$. The yield is ~70 per cent and the final product is obtained water solution free from solids.

1710 Preparation of Carrier-Free Ce Activity by N E Ballou. AECD-2530-I nd 5p

A procedure is presented for the isolation of carrier-free Ce activity from fission material, which makes use of the carrying of tetravalent Ce and the non-carrying of Ce by Zr $(IO_3)_4$.

1711 Radiochemical Determination of UX_1 Activity by N E Ballou and D N Hume. AECD-2530-J nd 3p

A procedure is described for the radiochemical determination of $UX_1(Th^{234})$ activity in the presence of fission products, which makes use of Th as a carrier for its isotope UX_1. Uranium UX_1 is isolated on Th by precipitation as fluoride hydroxide, iodate and oxalate.

1712 Papers for Plutonium Project Record, Volume 9B, Chapter 8, ed by N Sugarman. AECD-2531 nd Decl Mar 18 1949 60p For publication in NNES

The individual papers comprising this document are abstracted below.

1713 Determination of Ce Activity in Fission by W H Burgus and D W Engelkemeir. AECD-2531-A nd 7p

A procedure is presented for the isolation of Ce activity from fission material which makes use of the oxidation of Ce^{+3} to Ce^{+4} to precipitate $Ce(IO_3)_4$ away from the trivalent rare earths. Subsequent reduction of the quadrivalent Ce to trivalent Ce followed by iodate precipitation of Th serves to remove UX from the Ce.

1714 Determination of Rare Earth Activities in Fission by N E Ballou. AECD-2531-B nd 34p

In the procedure described, the rare earth elements are separated from other elements by precipitation from an acid solution with excess HF. The fluorides are readily dissolved by treatment with HNO_3 and H_3BO_3 due to the formation of the complex ion, BF_4. Cerium is separated directly

RARE EARTHS AND RARE EARTH COMPOUNDS (continued)

from the boric acid solution and the other rare earths by oxidation with $KClO_3$ and HNO_3 and precipitation of ceric iodate. $UX_1(Th^{234})$ is removed from Ce by dissolving the ceric iodate in HNO_3 and H_2O_2, directly precipitating zirconium iodate. Cerium in the trivalent state remains in solution. The La group is separated from the Y group by precipitation of the potassium lanthanum carbonate. The chemical yield determinations are made by weighing the hydrated oxalates dried under controlled conditions.

1715 Improved Determination of Ce and Rare Earth Activities in Fission by W F Boldridge and D N Hume. AECD-2531-C nd 13p

A study has been made of the separation of Ce from the trivalent rare earths by oxidation and precipitation as $Ce(IO_3)_4$. Oxidation in the cold by bromate in HNO_3 and precipitation by addition of 0.35 M HIO_3 has been found most satisfactory. A revised procedure for the determination of Ce activity is given and modifications for the improvement of the trivalent rare earth analysis are presented.

1716 Cerous-Ceric Ion Exchange by J Seiler, W Rubinson and R R Edwards. AECD-2531-D nd 6p

The distribution of Ce activity between Ce^{+3} and Ce^{+4} carriers has been studied to determine the exchange of charge between trivalent and quadrivalent Ce. Experiments indicate that exchange is rapid and complete.

1717 Spark Spectra of Elements 43 and 61 by D L Timma. AECD-2540 (MonC-166) Sept 20 1946 Decl Mar 2 1949 18p

The object of this work was to find some of the more sensitive lines of elements 61 and 43 in the ultra-violet region for use in qualitative detection of these elements. The copper spark method was used for exciting the spectrum of 61; the spectrum of 43 was excited by a controlled spark from a Baird source unit equipped with a synchronous interrupter. Tables listing wave lengths, intensities, and interfering lines of impurities present in the samples, are given for the characteristic spark lines of both elements.

1718 The L Spectrum of Element 61 by W F Peed, E J Spitzer and L E Burkhart. AECU-161 (Y-355) Feb 24 1949 6p

The L spectra of element 61 was measured. The wavelengths were calculated and are shown in a table with values obtained by previous workers.

1719 The Absorption Spectrum of Neodymium Bromate Crystals by A Benton and E L Kinsey Phys Rev 75 888 (1949) Mar 1 (Letter to the editor)

The work of Kinsey and Krueger [Phys Rev 62 82 (1942)] in investigating the visible absorption spectrum of neodymium crystals with polarized light has been extended to the ultra-violet region of the spectrum. One interesting result of this work is that spectra obtained with thin (0.32 mm) crystals of $Nd(BrO_3)_3 \cdot 9H_2O$ and $Nd(BrO_3)_3 \cdot 9D_2O$ are identical in all respects except one: the strong line which appears in the former at 3469A (28826 cm^{-1}). This shift of one and only one strong line, which occurs in both polarizations, is so remarkable that a photograph of it made on a large Littrow type Bausch and Lomb spectrograph is reproduced in this preliminary note. The shift appears to be in some way connected with an interaction between electronic energy levels of the Nd^{+++} ion and those of curtailed rotations of the water molecules in the crystal lattice.

The ultraviolet absorption spectrum of neodymium bromate was found to have only one group of very strong, fairly sharp lines at 3562, 3552, 3538, 3509, and 3469A. These lines were shown to be the result of electronic transitions from the $^4I_{9/2}$ ground state of Nd^{+++} to each of the 5 component levels into which the $^2G_{7/2}$ upper state is split by the crystal field. The analysis also furnished the M quantum numbers associated with each level.

RARE EARTHS AND RARE EARTH COMPOUNDS (continued)

1720 **Approximate Quantitative Semi-microanalytical Determination of Cerium and of the Totality of Rare Earths in Ores and Minerals (Kolichestvennoe priblizhennoe polumicroopredelenie tseriya i summy redkikh zemel' v rudakh i mineralakh) by N S Poluektov and M P Nikonova** Zhurnal Analiticheskoi Khimii 3 354-361 (1948) Nov-Dec (In Russian)

A description is given of an approximate, semi-microchemical method of determination of cerium content and of the total rare-earth content in ores and rocks, under conditions of field analytical work. Cerium is determined by means of a colorimetric reaction with hydrogen peroxide in carbonate solution in the presence of sodium citrate; the total rare-earth content is found semi-gravimetrically. A removable platinum cup was added to the microbalance permitting direct weighing of calcined precipitates.

1721 **The Isotopic Constitution of Dysprosium by Mark G Inghram, Richard J Hayden and David C Hess, Jr** Phys Rev 75 693-694 (1949) Feb 15 (Letter to the editor)

The discrepancies between the values of Wahl [Suomen Kemistiseuran Tiedonatoja 51 64 (1942)] and the earlier investigators and the large errors inherent in the photometric method have led the authors to determine the relative abundances of the dysprosium isotopes electrometrically. The table below compares the values obtained with the results obtained previously:

Investigator	156	158	160	161	162	163	164
Aston	---	---	---	22.0	24.0	24.0	28.0
Dempster	---	0.1	1.5	---	---	---	---
Wahl	---	0.1	trace (0.1)	21.1	26.6	24.8	27.3
Inghram, Hayden, and Hess	0.0524 ±0.0005	0.0902 ±0.0009	2.294 ±0.011	18.88 ±0.09	25.53 ±0.13	24.97 ±0.12	28.18 ±0.14

The following values were also determined for possible isotopes: $Dy^{154} < 0.002\%$, $Dy^{155} < 0.002\%$, $Dy^{157} < 0.002\%$, $Dy^{159} < 0.008\%$, $Dy^{165} < 0.011\%$ and $Dy^{166} < 0.002\%$.

SCIENTIFIC RESEARCH AND LABORATORIES

1722 **The Role of Microchemistry in Atomic Energy Development by F T Hagemann** Forecast 11 85-87 (1949) March

Some of the equipment and techniques developed for handling microquantities of radioactive materials are described briefly. Photographs of the following are given: microfurnace, microbalance, micropipette, microcone. 7 figures.

SPECTROGRAPHY

1723 **The Microwave Spectrum of Carbonyl Selenide by M W P Strandberg, T Wentink, Jr., and A G Hill** Phys Rev 75 827-832 (1949) March 1

This article is based on MIT Research Laboratory of Electronics Technical Report 78 (NP-455). An abstract of the document appeared in Nuclear Science Abstracts as abstract No. II-328.

1724 **Second-Order Stark Effect of Methyl Chloride by Robert Karplus and A. Harry Sharbaugh** Phys Rev 75 889-890 (1949) Mar 1 (Letter to the editor)

The first rotational transition, (J,K) = (0,0) → (1,0), of $C^{12}H_3Cl^{37}$ has been reexamined using the square wave Stark Effect modulation technique [Wilson and Hughes, Phys Rev 71 562 (1947); Karplus, Phys Rev 73 1027 (1948)]; it was found that these lines exhibit a second-order Stark Effect. It is shown that this is to be expected on theoretical grounds. Curves showing the field dependence of the positions of these absorption lines and of their intensities are given. Incidental to this study, the quadrupole coupling constants were measured for the two isotopic species, and were found to be in substantial agreement with those reported by Gordy et al [Phys Rev 74 243 (1948)].

TRACER APPLICATIONS - BIOLOGY

1725 Applications of Phosphorus of Mass Thirty Two to Problems of Soil Fertility and Fertilizer Utilization by S B Hendricks and L A Dean [In "Proceedings of the Auburn Conference on the Use of Radioactive Isotopes in Agricultural Research," Dec 18-20, 1947, Auburn, The Alabama Polytechnic Institute, 76-86 (1948)]

Tracer techniques involving P^{32} in problems of fertility of soil with respect to phosphate and the availability of phosphatic fertilizers when applied to soils are illustrated by laboratory, field and growth chamber experiments carried out by a team of about 10 workers.

1726 Distribution of Tracer Doses of Methionine Tagged with Radiosulfur in Normal and Neoplastic Tissue by Arnold J Kremen, Samuel W Hunter, George E Moore and Claude R Hitchcock Cancer Research 9 174-176 (1949) Mar

Studies of the distribution of tracer doses of D-L-methionine tagged with S^{35}(0.75 μc) in mice with spontaneous and transplanted neoplasms indicate a high initial concentration of radiomethionine in liver, tumor, kidney, and intestinal wall. Any therapeutic possibilities relating to introducing radioactive sulfur into tumor must await animal trial.

1727 On the Utilization of Exogenous Sulfate Sulfur by the Rat in the Formation of Ethereal Sulfates as Indicated by the Use of Sodium Sulfate Labeled with Radioactive Sulfur by Dominic D Dziewiatkowski J Biol Chem 178 389-393 (1949) Mar

Rats given sodium sulfate containing S^{35} incorporate some of the sulfur into the ethereal sulfate sulfur fraction of the urine. The amount incorporated can be increased by the simultaneous administration of phenol. On the basis of the close agreement in the specific activities of the inorganic sulfate, total sulfate, and ethereal sulfate sulfur fractions in a number of the experiments it is suggested that, if sulfur from sources other than pre-existing sulfate is used in the in vivo synthesis of ethereal sulfates, the sulfur is first converted to sulfate before it is conjugated with phenols.

1728 Radioisotopes in Medicine by Geogre M Lyon Military Surgeon 104 171-175 (1949) March

This is not an exhaustive survey of the work which has been attempted with radioisotopes. Illustrative examples of the types and techniques of applications that can be made of radioisotopes in the fields of medicine and biology are presented.

1729 Rate of Excretion of Radioactive Sulfur and its Concentration in Some Tissues of the Rat After Intraperitoneal Administration of Labeled Sodium Sulfate by Dominic D Dziewiatkowski J Biol Chem 178 197-202 (1949) Mar

The excretion by rats in urine and feces of S^{35} in the form of sodium sulfate appears to be rapid and accounts for the major portion of the S^{35} given. Approximately 95% was found to have been eliminated by these routes at the end of 120 hours. During that period the concentration of S^{35} in the blood, liver, and brain fell to relatively low levels. A similar concentration of S^{35} in the blood and liver was reached at 48 hours, and in the blood and brain at 72 hours. In contrast to the rapid fall observed in the liver and blood, the concentration of S^{35} was found to increase until about the 8th hour in bone and until the 24th hour in bone marrow. The subsequent fall in the S^{35} concentration of the bone and bone marrow was also slower than in blood, liver, and brain.

1730 Secretion of Radioactive Calcium in the Hen's Egg by C L Comar and J Clyde Driggers Science 109 282 (1949) Mar 18

Approximately 1 mg of Ca^{45} as a solution of the chloride, with an activity of 15 μc, was administered into the lower esophagus of the fasted hen. For a period of 20 days after dosage, each egg laid was analyzed for total calcium and Ca^{45} uptake in the yolk, white, and shell. The total percentage accumulations in the yolks, whites, and shells of the 14 eggs collected after dosage were 0.7, 0.2, and 40, respectively. It was calculated from the total dietary calcium intake and output in the eggs and the reported data that a maximum of from 60 to 75% of the calcium in the egg reached there directly from the ingested calcium, the remainder probably being drawn from the body stores.

TRACER APPLICATIONS - BIOLOGY (continued)

1731 Tracers in Biochemical Investigations by W J Arrol Analyst 73 660-662 (1948) Dec

The use of tracer techniques in biochemical investigations is discussed and a few isolated examples of the types of experiments possible using such techniques are described. The following are discussed briefly: (1) the identification of compounds into which radioiodine has been incorporated after the administration of radio-iodide to surviving thyroid tissue; (2) the use of chromatographic systems for the attempted separation of radioactive residue and inactive carrier; (3) the use of labelled compounds in the study, in vitro, of the variation with time of the specific activities of 2 compounds for the determination of the biological precursors of compounds in a various systems; (4) variants of the radioautographic technique; (5) the isotope dilution technique. 7 references.

1732 The Utilization of the α-Carbon Atom of Glycine for the Formation of Acetic and Aspartic Acids by David B Sprinson J Biol Chem 178 529-530 (1949) Mar

By using glycine labeled with C^{14} in the methylene group it was demonstrated that in the rat acetic and aspartic acids can be formed from the glycine.

TRACER APPLICATIONS - CHEMISTRY

1733 Isotopes as Tracers in Analytical Chemistry by A H W Aten Jr Analyt Chim Acta 2 492-499 (1948) Dec

The principles of the application of tracers in analytical chemistry are reviewed and examples of the different kinds are given. The determination of elements by induced radioactivity and by neutron absorption is described.

TRACER APPLICATIONS - INDUSTRY

1734 Using the "Nuclear Projectile"; Radioactive Tools for Investigation and Measurement. Chem Age 59 819-820 (1948) Dec 18

A summary is given of a paper "The application of radioactive elements in industry" which was presented by Dr. Seligman before the Society of Chemical Industry on Dec. 6, 1948. Industrial uses of radioisotopes make use of either the ionizing power or the penetrating power of the radiation or of the atom itself as a tracer. The ionizing power may be used to dissipate static electricity. The penetrating power of radiation may be used as an alternative to x-rays for taking radio-autographs. The use of radioisotopes as tracers is of advantage because of the low limit of detection. Active sulfur is used in investigations of the mechanism of rubber vulcanization. Active carbon is used in studies of the mechanism of the etching of steel.

TRACER APPLICATIONS - PHYSICS

1735 The Use of Radioactive Tracers in a Study of Activator Distribution in Infrared-Sensitive Phosphors by R W Mason, C F Hiskey and Roland Ward J Amer Chem Soc 71 509-514 (1949) Feb

A technique for filtering fused salt solutions at 1000°C has been described. The distribution of small quantities of europium, cerium and samarium between phosphor base materials (strontium sulfide and strontium selenide) and saturated solutions of the bases in the fluxes (strontium chloride and lithium fluoride) has been studied in the neighborhood of 1000°C with the aid of radioactive tracers.

TRANSURANIC ELEMENTS

1736 Hydrolytic Behavior of Plutonium (III); Acid-Base Titrations of Plutonium (III) by K A Kraus and J R Dam. AECD-2543 (CN-2832) June 30 1945 Decl Mar 23 1949 18p For publication in NNES

Through acid-base titrations, the pK of the acid constant of Pu^{+3} (calculated for activities) was found to be approximately 6.95. Comparison of this value with that of Pr^{+3} and that calculated on

TRANSURANIC ELEMENTS (continued)

theoretical grounds was carried out and found to be satisfactory. Pu(III) was found to be oxidizable by hydrogen peroxide near pH 5 and by water above pH 7.2 in agreement with the oxidation-reduction potentials for the Pu(III)/Pu(IV) couple.

1737 Hydrolytic Behavior of Plutonium (V); Acid Constant of PuO_2^+ by K A Kraus and J R Dam. AECD-2544 (CN-2817) June 30 1945 Decl Mar 23 1949 33p For publication in NNES

The general hydrolytic problem of plutonium(V) as well as that of other ions of oxidation state plus five is discussed. Acid base titrations were carried out to determine the acid constant of PuO_2^+. The result showed that PuO_2^+ hydrolyzes only at a very high pH, and that the pK of its acid constant (activity constant) is larger than or equal to 9.7. This value is in good agreement with that expected on theoretical grounds by analogy with PuO_2^{++}. Disproportionation of plutonium(V) into plutonium(IV) and plutonium(VI) occurs above pH 7 at a concentration of 1.8 g Pu/liter. The pH at which disproportionation starts, increases rapidly with dilution. The precipitates resulting from the disproportionation of plutonium(V) contain Pu(IV), Pu(V), and Pu(VI), showing that $Pu(OH)_4$ can carry Pu(V) and Pu(VI).

1738 Hydrolytic Behavior of Plutonium (VI); Acid-Base Titrations of Plutonium (VI) by K A Kraus and J R Dam. AECD-2545 (CN-2831) Oct 14 1946 Decl Mar 23 1939 33p For publication in NNES

Acid-base titrations of Pu(VI) solutions in 1 M sodium perchlorate and 1 M sodium nitrate have been carried out. Analysis of the titration curves, assuming the successive equilibria: $PuO_2^{++} + 2H_2O \rightleftharpoons PuO_2OH^+ + H_3O^+$ (K_1) and $PuO_2OH^+ + 2H_2O \rightleftharpoons PuO_2(OH)_2 + H_3O$ (K_2), was fairly successful and yielded $pKm_1 = 5.71$ for both types of solutions. (The pK values were calculated using concentrations of all species involved, including that of H_3O^+ and taking $K_1 = K_2$). The close agreement of the pK values for the 1 M perchlorate and 1 M nitrate solutions excluded strong complexing of PuO_2^{++} by nitrate ions in 1M NO_3^-. A discussion of the general method of calculation of acid constants for dibasic acids with hydrolytic overlap is given.

It has been confirmed that a titration of an acidic Pu(VI) solution with sodium hydroxide does not give the same curve as the "back-titration" of a basic Pu(VI) solution with perchloric acid. The "back-titration" curve is generally at lower pH than the titration curve with hydroxide and pronounced pH drifts toward higher pH readings accompany this hysteresis effect below approximately pH 7. Fourteen references.

1739 Papers for Plutonium Project Record, Volume 9B, Chapter 7 edited by N Sugarman. AECD-2555 nd Decl Mar 25 1949 73p

This document is a collection of papers concerning fission yields in plutonium and uranium. The individual papers are listed below.

Determination of Absolute Slow Fission Yields in Pu^{239}, Parts I and II by D. W. Engelkemeir, M. S. Freedman, J. A. Seiler, E. P. Steinberg, and L. Winsberg; Part III by M. S. Freedman and E. P. Steinberg; Part IV by A. Goldstein, E. J. Hoagland, S. Katcoff, C. Schwob, J. Seiler, N. Sugarman, L. Winsberg.

Determination of Absolute Fast Fission yields in Pu^{239}, Part I by D. W. Engelkemeir, M. S. Freedman, J. A. Seiler, E. P. Steinberg, and L. Winsberg; Part II and II by M. S. Freedman and E. P. Steinberg. Determination of Absolute Slow Fission Yields in Uranium, Part I by D. W. Engelkemeir, T. B. Novey, and D. Schover; Part II by M. S. Freedman and S. W. Engelkemeir. Relative Fission Yield Experiments, Introduction by E. P. Steinberg and M. S. Freedman; Part I and II by D. W. Engelkemeir, J. A. Seiler, E. P. Steinberg and L. Winsberg; Part III and IV by M. S. Freedman and E. P. Steinberg; Part V by M. S. Freedman, R. P. Schuman and E. P. Steinberg; Part VI by R. P. Schuman and E. P. Steinberg; Part VII by S. Katcoff, E. J. Hoagland, C. Schwob, J. A. Seiler and N. Sugarman; Part VIII (The Fission Yield of the Chair of Mass Number 72) by J. A. Seiler; Part IX (The Determination of Pu Yields Relative to U Yields) by B. Finkle, E. Goagland, S. Katcoff, and N. Sugarman.

TRANSURANIC ELEMENTS (continued)

Thermal U^{235} Fission Yields by D. W. Engelkemeir, John Seiler, E. P. Steinberg, and Lester Winsberg, U^{238} Fission Yields by D. W. Engelkemeir, John Seiler, E. P. Steinberg, and Lester Winsberg; Summary of Results of Fission Yield Experiments by E. P. Steinberg and M. S. Freedman.

1740 The Oxidation States of Neptunium in Aqueous Solution by J C Hindman, L B Magnusson and T J LaChapelle J Amer Chem Soc 71 687-693 (1949) Feb

This article is based on MDDC-1266. An abstract of the document has been listed in Abstracts of Declassified Documents 1 702 (1947) Dec 10.

URANIUM AND URANIUM COMPOUNDS

1741 The System Uranyl Nitrate-Water-Organic Solvent by Leonard I Katzin and James C Sullivan. AECD-2537 (ANL-HDY-615) Dec 1948 Decl Mar 18 1949 46p

The ternary systems uranyl nitrate-water-organic solvent have been studied with the following organic solvents: diethyl ether, ethylene glycol diethyl ether (diethyl cellosolve), hexyl ether, acetone, methyl isobutyl ketone, isobutyl alcohol and tertiary butyl alcohol. For each system tables are given listing the per cent water and uranyl nitrate in the aqueous and organic phases and the composition of the uranyl nitrate solvates of the solid phase; phase diagrams have also been constructed for the several ternary systems. The form of the uranyl nitrate which is in solution, the electron donor behavior of the solvents, the nature of the various solid phases, and general considerations concerning the solubility of inorganic salts in organic solvents are discussed.

1742 The Freezing Point of Uranium by A I Dahl and H E Cleaves. AECD-2541 nd Decl Mar 22 1949 13p Proposed for publication in J Research Nat'l Bur Standards

The data obtained in this investigation indicate that the freezing point of uranium of about 99.99 percent purity is 1133 ± 1°C. The freezing point was not notably affected by the crucible material; similar values for the freezing point being obtained in beryllia, thoria and graphite crucibles. Holding the metal at temperatures just above the melting point for several hours resulted in a decrease in the content of several impurities, by volatilization and by migration to the top and side walls. This increase in the purity of the metal was accompanied by an increase in the freezing temperature to a final constant value, 5 or 6°C above the initial freezing temperature.

1743 Further Classification of the Spectrum of Singly-Ionized Uranium by J R McNally Jr and G R Harrison. AECU-153 (Y-340) Feb 11 1949 19p

The present status of the classification of the spectrum of singly-ionized uranium is discussed. Analysis of this spectrum was begun at MIT in 1941 but publication was withheld during the war for security reasons. During this period a preliminary analysis of the complex ion spectrum was published by Schuurmans [Over de analyse van enig complexe spectra (Th. en U) Diss. Amsterdam 1946] and also by Schuurmans, Van de Bosch and Dijkwel [Physica 13 117 (1947)]. The early Zeeman effect studies at the Massachusetts Institute of Technology Spectroscopy Laboratory have been supplemented by isotope-shift investigations in the Y-12 laboratories of Carbide and Carbon Chemicals Corporation. The application of IBM equipment to the classification of the spectrum has also materially aided the analysis of the complex energy structure of U II.

1744 The Preparation of Uranium Hexafluoride by Thomas D O'Brien. Naval Research Laboratory Report No P-1744 May 21 1941 13p

It was found that quantities of uranium hexafluoride may be prepared by the direct fluorination of uranium metal, a 10% nickel-90% uranium alloy, or anhydrous uranium tetrafluoride. Both the pure metal and the alloy gave good yields and required no preliminary treatment, while yields from the tetrafluoride seemed to be entirely dependent on the amount of water present. Dehydration was accomplished by heating precipitated uranium tetrafluoride at 150°C for several hours in a vacuum oven.

URANIUM AND URANIUM COMPOUNDS (continued)

Temperatures of 250°C or above were found necessary to fluorinate the uranium tetrafluoride to the hexafluoride. Fluorine was generated by the electrolysis of molten potassium bifluoride in an all copper apparatus.

1745 Prolonged Photoluminescence of Uranyl Compounds at the Temperature -185°C (Dlitel'naya fotoluminestsentsiya uranilovykh soedinenii pri temperature -185°C) by Z M Sverdlov and A N Sevchenko Doklady Akad Nauk SSSR 61 821-823 (1948) Aug 11 (In Russian)

Crystals of various uranyl salts were illuminated by ultraviolet rays at -185°C. It was found that short waves ($\lambda \cong 250.0$ mμ) produced a luminescence effect of 5 to 8 sec duration, while long waves (λ = 366.0 mμ) produced no measurable effect. Uranyl salts are thus capable of a prolonged photoluminescence (at low temperature), not observed by previous experimenters who had found a cathodoluminescence only [Nichols and Howes, Fluorescence of the Uranyl Salts, Washington (1919)]. The present authors obtained the spectrum of the prolonged photoluminescence of potassium-uranyl sulfate. Although showing the bands of the luminescence spectrum of uranyl salts [Wawilow and Lewschin, Z Physik 48 397 (1928)], the spectrum lacks the characteristic discrete structure of the bands at -185°C; it also lacks the lines 511.5, 534.2, and 558.9 mμ which correspond to purely molecular transitions in the crystal.

1746 Some Observations on the Electro-Chemistry of Uranium by H G Heal Trans Faraday Soc 45 1-11 (1949) Jan

Data on the polarography of uranium salt solutions, in the valencies of three, four, and six are given. These measurements are compared with the older published work on the oxidation-reduction potentials of the uranium ions, and the two sets of figures related by means of the hypothesis of an unstable UO_2^+ ion, which is also held responsible for the shift of potential of a U^{VI}-U^{IV} electrode under illumination. New figures are given for several oxidation-reduction potentials.

1747 Some Reactions of Uranylferrocyanide by Moritz Kohn Analyt Chim Acta 3 34-35 (1949) Jan

Uranyl ferrocyanide is soluble in phosphoric acid, hydrofluoric acid, potassium fluoride, ammonium fluoride, sodium carbonate, sodium bicarbonate, potassium carbonate, potassium bicarbonate. These reactions can be used in spot tests.

1748 Unstable Ions of Quniquavalent Uranium by H G Heal and J G N Thomas Trans Faraday Soc 45 11-20 (1949) Jan

The formation and disproportionation of an unstable UO_2^+ ion in H_2SO_4 solutions of U^{IV} and U^{VI} have been studied. The technique was to measure the potential of a platinum reference electrode in the solution, which is determined by the U^{VI}/U^V activity ratio. U^V is formed by reactions of U^{VI} with U^{IV}, which is accelerated by light, and by electrolytic reduction of U^{VI}, attaining a maximum concentration of approximately 10^{-5} M under the conditions of our experiments. Its disproportionation is of the second order in U^V, and approximately of the first order in H^+. The activation energy of the disproportionation is about 9,500 cal. A number of values for the rate constants are given.

1749 Uranium Hydride -- III Dispersions in Mercury by J C Warf, A S Newton, T A Butler and F H Spedding Nucleonics 4 No. 3, 43-47 (1949) March

This article is based on MDDC-1586. An abstract of the document has been listed in Abstracts of Declassified Documents 2 54 (1948) Jan 31.